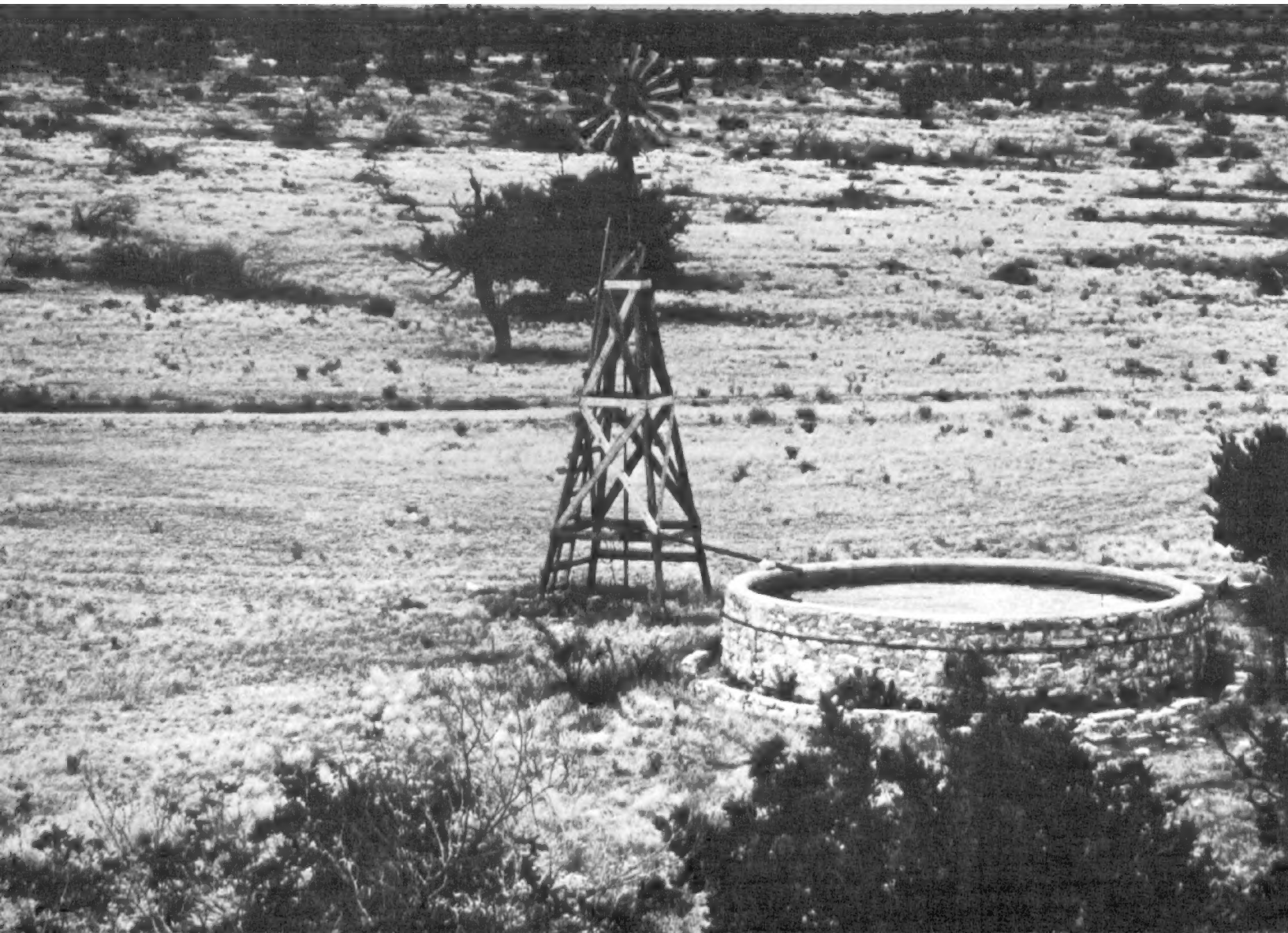
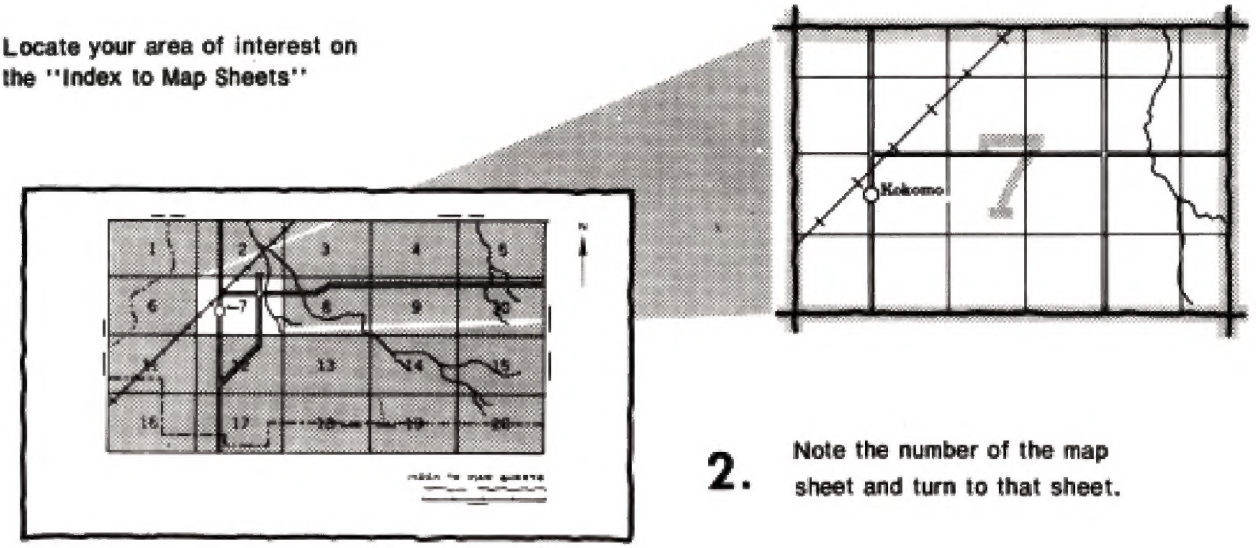
Soil Survey of Nolan County, Texas

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Texas Agricultural Experiment Station



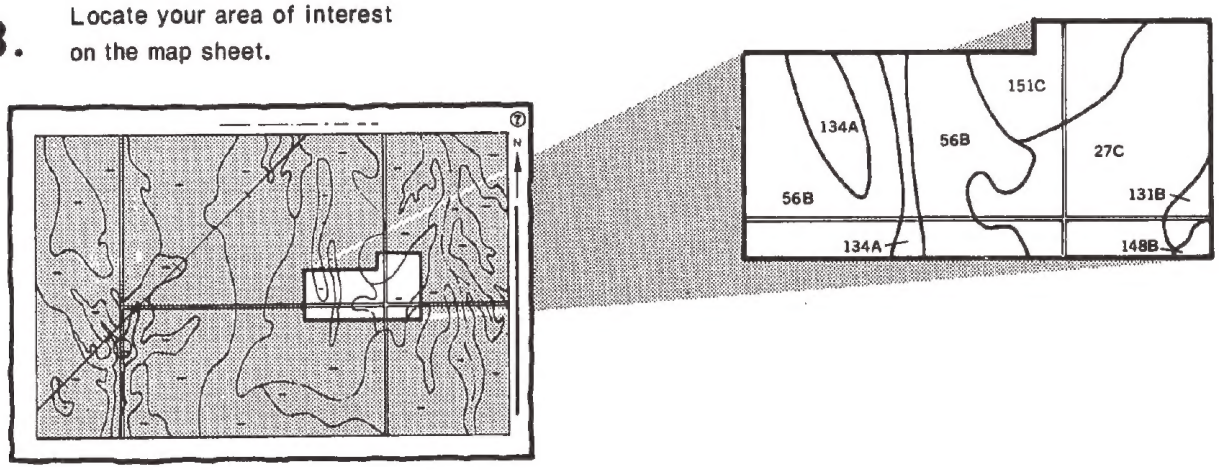
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

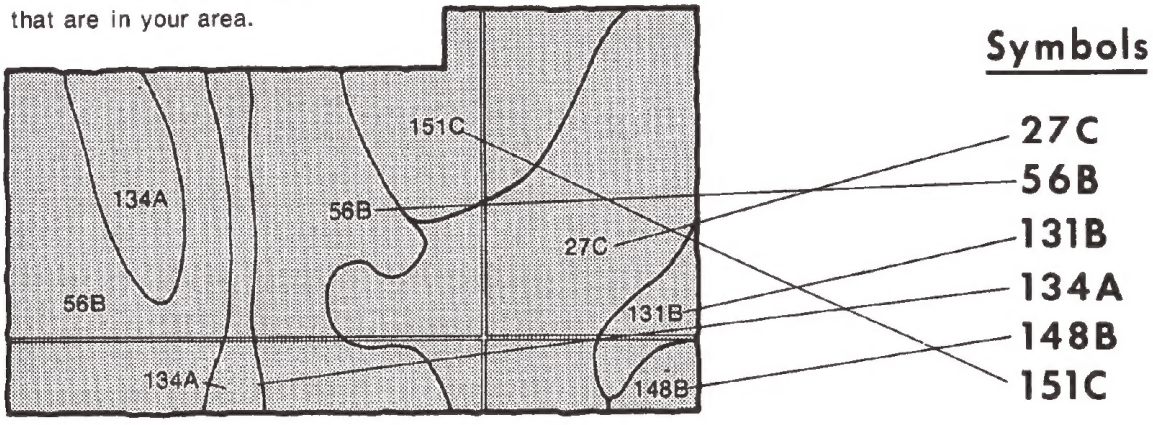


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

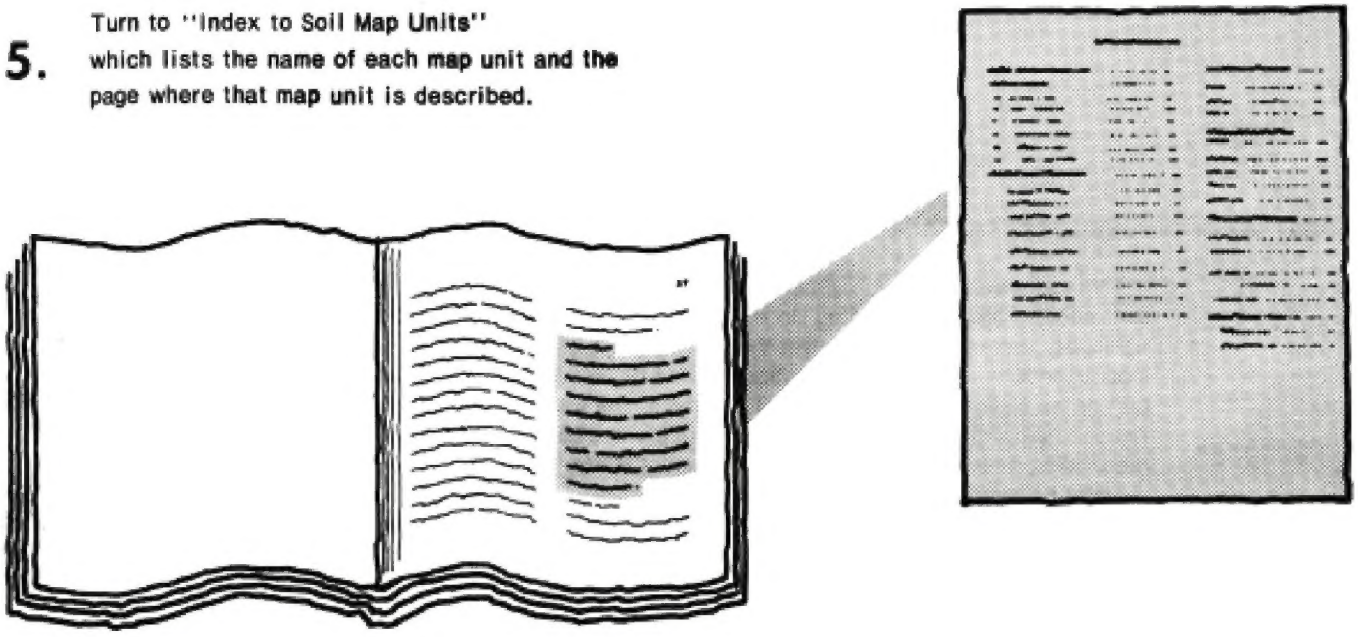


4. List the map unit symbols that are in your area.

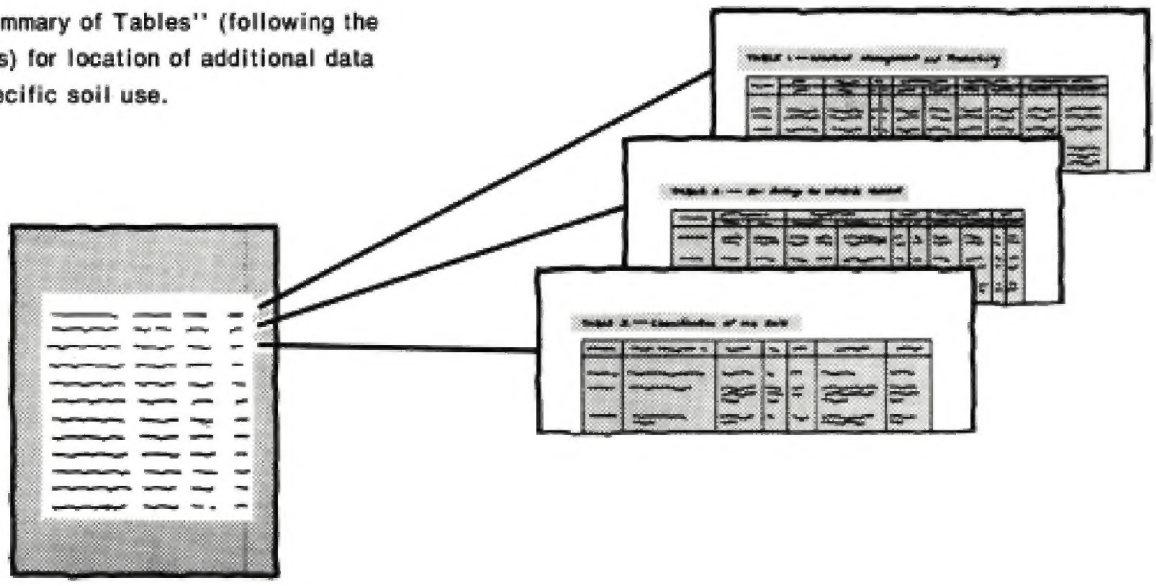


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1973-77. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1979. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Nolan County Soil and Water Conservation District.

Cover: A typical area of Ector very gravelly clay loam, 1 to 8 percent slopes, in rangeland.

contents

Index to map units iv
Summary of tables v
Foreword vii
General nature of the county 1
Settlement and population 1
Climate 1
Agriculture 2
Natural resources 2
How this survey was made 2
General soil map units 5
Soil descriptions 5
Broad land use considerations 8
Detailed soil map units 9
Soil descriptions 9
Use and management of the soils 49
Crops 49
Rangeland 50
Windbreaks and environmental plantings 51
Recreation 52
Wildlife habitat 52
Engineering 53
Soil properties 59
Engineering index properties 59
Physical and chemical properties 60
Soil and water features 61
Engineering index test data 62
Classification of the soils 63
Soil series and their morphology 63
Formation of the soils 79
Parent material 79
Climate 79
Plants and animals 79
Relief 79
Time 80
References 81
Glossary 83
Tables 89

soil series

Acme series 63
Burson series 64
Cobb series 64
Colorado series 64
Cosh series 65
Cottonwood series 65
Ector series 65
Gageby series 66
Kavett series 66
Knoco series 66
Latom series 67
Lozier series 67
Mereta series 67
Miles series 68
Nipsum series 68
Paducah series 69
Pitzer series 69
Potter series 69
Quinlan series 70
Randall series 70
Roscoe series 71
Rotan series 71
Rowena series 72
Sagerton series 72
Shep series 73
Spade series 73
Speck series 74
Tarrant series 74
Texroy series 74
Tillman series 75
Tobosa series 75
Valera series 76
Veal series 76
Vernon series 77
Volente series 77
Woodward series 78

Issued September 1981

index to map units

1—Acme-Cottonwood complex, 1 to 5 percent slopes 9
2—Burson-Quinlan association, hilly 11
3—Cobb fine sandy loam, 1 to 5 percent slopes 11
4—Cobb-Miles complex, 0 to 1 percent slopes 12
5—Cobb-Miles complex, 1 to 3 percent slopes 12
6—Colorado loam, occasionally flooded 13
7—Colorado loam, frequently flooded 14
8—Cosh fine sandy loam, 1 to 5 percent slopes 14
9—Ector very gravelly clay loam, 1 to 8 percent slopes 15
10—Ector-Rock outcrop association, hilly 15
11—Gageby clay loam, occasionally flooded 16
12—Gageby clay loam, frequently flooded 18
13—Kavett clay, 0 to 1 percent slopes 18
14—Kavett clay, 1 to 3 percent slopes 19
15—Knoco clay, 1 to 8 percent slopes 20
16—Latom-Rock outcrop association, rolling 20
17—Lozier-Rock outcrop association, steep 21
18—Mereta clay loam, 0 to 1 percent slopes 21
19—Mereta clay loam, 1 to 3 percent slopes 22
20—Miles loamy fine sand, 0 to 3 percent slopes 22
21—Miles loamy fine sand, 3 to 5 percent slopes 23
22—Miles fine sandy loam, 1 to 3 percent slopes 23
23—Miles fine sandy loam, 3 to 5 percent slopes 24
24—Nipsum clay loam, 0 to 1 percent slopes 24
25—Nipsum clay loam, 1 to 3 percent slopes 25
26—Paducah loam, 1 to 3 percent slopes 26
27—Paducah loam, 3 to 5 percent slopes 26
28—Pits 27
29—Pitzer gravelly loam, 1 to 8 percent slopes 27
30—Potter gravelly loam, 1 to 20 percent slopes 28
31—Quinlan loam, 1 to 5 percent slopes 29
32—Quinlan-Burson-Woodward association, rolling 30
33—Randall clay 30
34—Roscoe clay 31
35—Rotan clay loam, 0 to 1 percent slopes 31
36—Rotan clay loam, 1 to 3 percent slopes 33
37—Rowena clay loam, 0 to 1 percent slopes 33
38—Rowena clay loam, 1 to 3 percent slopes 34
39—Sagerton clay loam, 0 to 1 percent slopes 35
40—Sagerton clay loam, 1 to 3 percent slopes 35
41—Shep loam, 1 to 5 percent slopes 36
42—Shep loam, 5 to 12 percent slopes 36
43—Spade loam, 1 to 3 percent slopes 37
44—Spade loam, 3 to 5 percent slopes 37
45—Speck clay loam, 0 to 1 percent slopes 38
46—Speck clay loam, 1 to 3 percent slopes 38
47—Tarrant stony clay, 1 to 8 percent slopes 39
48—Texroy loam, 0 to 1 percent slopes 39
49—Tillman clay loam, 0 to 1 percent slopes 40
50—Tobosa clay, 0 to 1 percent slopes 41
51—Tobosa clay, 1 to 3 percent slopes 42
52—Valera silty clay, 0 to 1 percent slopes 42
53—Valera silty clay, 1 to 3 percent slopes 43
54—Veal loam, 1 to 5 percent slopes 43
55—Vernon clay, 1 to 3 percent slopes 44
56—Volente-Gageby complex, 0 to 5 percent slopes 44
57—Woodward loam, 1 to 3 percent slopes 46
58—Woodward loam, 3 to 5 percent slopes 46

summary of tables

Temperature and precipitation (table 1) 90

Freeze dates in spring and fall (table 2) 91
Probability. Temperature.

Growing season (table 3) 91
Probability. Daily minimum temperature.

Suitabilities and limitations of general soil map units for specified uses (table 4) 92
Extent of area. Cultivated crops. Rangeland. Urban uses. Recreation areas.

Acreage and proportionate extent of the soils (table 5) 93
Acres. Percent.

Yields per acre of crops (table 6) 94
Cotton lint. Grain sorghum. Wheat.

Capability classes and subclasses (table 7) 97
Total acreage. Major management concerns.

Rangeland productivity (table 8) 98
Range site. Potential annual production.

Windbreaks and environmental plantings (table 9) 100
Trees having predicted 20-year average heights.

Recreational development (table 10) 103
Camp areas. Picnic areas. Playgrounds. Paths and trails. Golf fairways.

Wildlife habitat (table 11) 107
Potential for habitat elements. Potential as habitat for—Openland wildlife, Wetland wildlife, Rangeland wildlife.

Building site development (table 12) 110
Shallow excavations. Dwellings without basements. Dwellings with basements. Small commercial buildings. Local roads and streets. Lawns and landscaping.

Sanitary facilities (table 13) 114
Septic tank absorption fields. Sewage lagoon areas. Trench sanitary landfill. Area sanitary landfill. Daily cover for landfill.

Construction materials (table 14) 118
Roadfill. Sand. Gravel. Topsoil.

Water management (table 15) 121
Limitations for—Pond reservoir areas; Embankments, dikes, and levees; Aquifer-fed excavated ponds. Features affecting—Irrigation, Terraces and diversions, Grassed waterways.

Engineering index properties (table 16) 125
Depth. USDA texture. Classification—Unified, AASHTO. Fragments greater than 3 inches. Percentage passing sieve—4, 10, 40, 200. Liquid limit. Plasticity index.

Physical and chemical properties of the soils (table 17) 129
Depth. Clay. Moist bulk density. Permeability. Available water capacity. Soil reaction. Shrink-swell potential. Erosion factors. Wind erodibility group. Organic matter.

Soil and water features (table 18) 132
Hydrologic group. Flooding. High water table. Bedrock. Cemented pan. Risk of corrosion.

Engineering test data (table 19) 135
Classification. Grain-size distribution. Liquid limit. Plasticity index. Particle density. Shrinkage.

Classification of the soils (table 20) 138
Family or higher taxonomic class.

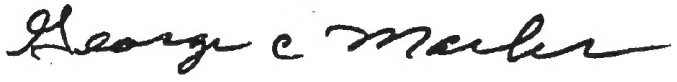
foreword

This soil survey contains information that can be used in land-planning programs in Nolan County, Texas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

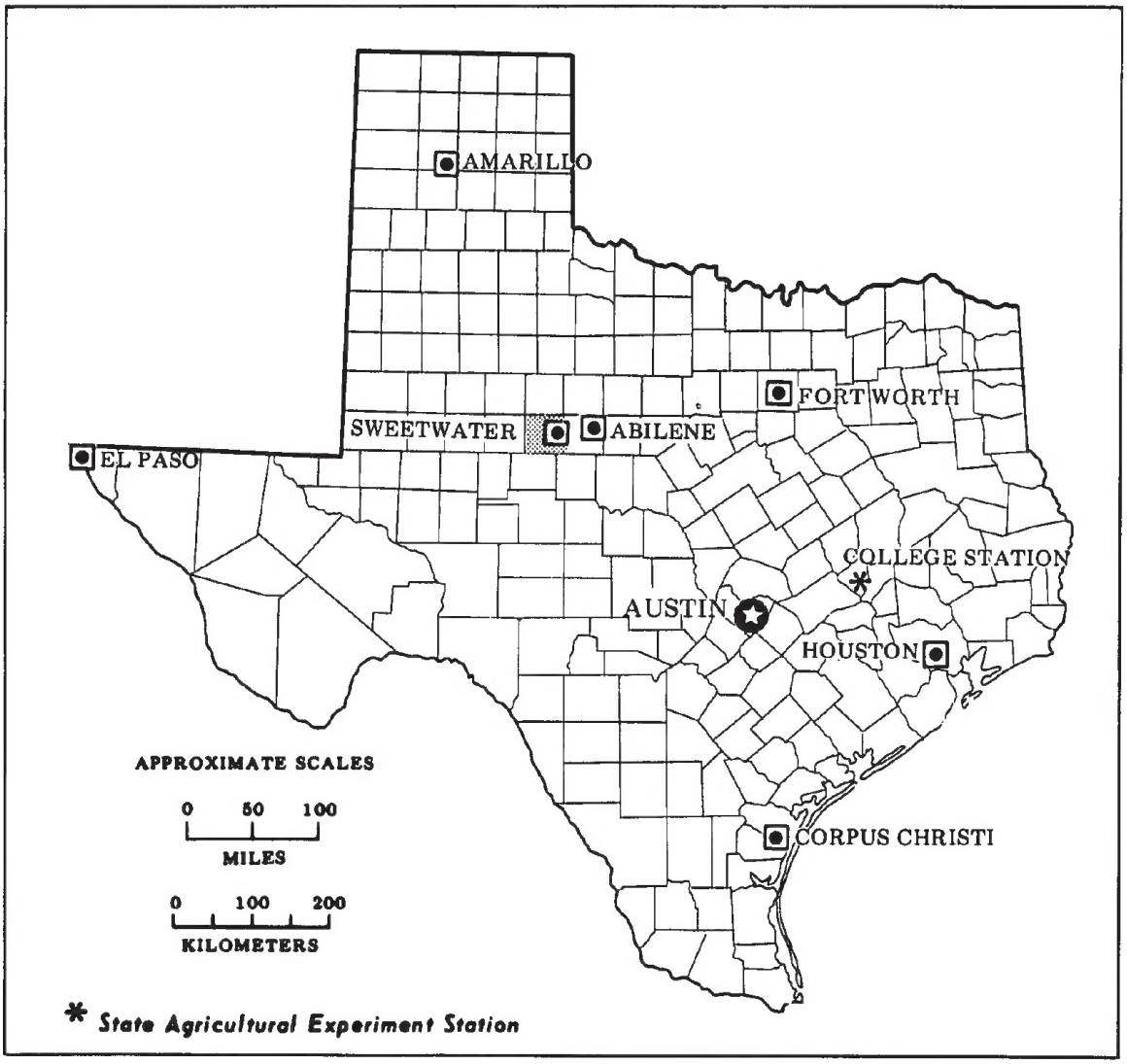
This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.



George C. Marks
State Conservationist
Soil Conservation Service



Location of Nolan County in Texas.

soil survey of
Nolan County, Texas

By A. C. Lowther, Soil Conservation Service

Fieldwork by Nathanial R. Conner, C. L. Girdner, William M. Miller, and Billy J. Wagner, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Texas Agricultural Experiment Station

Nolan County is in west-central Texas astride the western end of the Callahan Divide. It has a total area of 590,720 acres, or 923 square miles. Sweetwater, with a population of 12,220, is the county seat. Other towns in the county are Blackwell, Hylton, Maryneal, Nolan, and Roscoe.

The county is divided into three rather prominent areas with distinct differences in relief and drainage. The south-central portion of the county is a dissected limestone plain where the soils range from nearly level to steep breaks. This is in the Edwards Plateau Land Resource Area. In the northwestern corner, nearly level soils drain mainly into playas or depressional areas. This section is locally called "blackland" or "Roscoe Flats." The southwestern, west-central, and northeastern parts of the county consist of a gently sloping to gently rolling, moderately dissected red-bed plain. These areas are in the Rolling Plains Land Resource Area. The county is dissected by small, mostly intermittent streams. The major streams are Sweetwater Creek in northeastern Nolan County, Valley Creek in the southeast, Oak Creek in the south-central part, Champion and Silver Creeks in the west, and Cottonwood Creek in the northwest. The two lakes in the area are Lake Sweetwater and Lake Trammell.

Descriptions, names, and delineations of soils in this survey do not fully agree with those on soil maps for adjacent counties. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of the soils within the survey area.

general nature of the county

The paragraphs that follow provide general information concerning the county. Its settlement and population, climate, agriculture, and natural resources are described briefly.

settlement and population

Nolan County was named for Phillip Nolan, an adventurer, and was created out of the Young-Bexar Territory in 1876. One of the earliest structures was a grocery store established in a dugout on the east bank of a creek southeast of present-day Sweetwater. A post office was established there in March 1897.

By 1881 the Texas and Pacific Railroad began operation through Sweetwater. This event quickly brought about the settlement of Nolan County. According to the Bureau of the Census, in 1970 the population of Nolan County was 16,220. This is a decrease of 2,743, or 14 percent, from 1960. Future population is projected to increase by about 1 percent annually.

climate

In Nolan County, summers are hot and winters are alternately mild and very cool. Cold fronts repeatedly sweep over the area, causing sharp drops in temperature, but the cold air behind the fronts usually moderates quickly. Winter precipitation, often snowfall, is light. The total annual precipitation is usually adequate for wheat, sorghum, and range grasses.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Roscoe, Texas, in the

period 1951 to 1976. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 46° F, and the average daily minimum temperature is 32°. The lowest temperature on record, which occurred at Roscoe on January 12, 1973, is 1°. In summer the average temperature is 81°, and the average daily maximum temperature is 94°. The highest recorded temperature, which occurred on June 20, 1953, is 110°.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50° F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 23.5 inches. Of this, 16 inches, or 70 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 11 inches. The heaviest 1-day rainfall during the period of record was 6.20 inches at Roscoe on August 1, 1971. Thunderstorms occur on about 40 days each year, and most occur in May.

Average seasonal snowfall is 7.5 inches. The greatest snow depth at any one time during the period of record was 10 inches. On an average of 2 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The sun shines 80 percent of the time possible in summer and 70 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 14 miles per hour, in March.

Duststorms sometimes occur in spring, when strong dry winds blow over unprotected soils. Tornadoes and severe thunderstorms, some with hail, occur occasionally. These storms are local and of short duration, and the pattern of damage is variable and spotty.

Climatic data for this section were especially prepared for the Soil Conservation Service by the National Climatic Center, Asheville, North Carolina.

agriculture

When Nolan County was created, the only inhabitants were a few buffalo hunters. The first settlers found desirable soil and climatic conditions. Most brought cattle into the area, and this was the beginning of extensive ranching in the county. Most of the present cropland, however, has only been cultivated since about 1900 when cotton was first introduced into the area.

In the early years, practices to conserve soil and water were not known. In 1944 local farmers and ranchers organized the Upper Clear Fork Soil and Water Conservation District to serve Nolan and Fisher Counties. In January 1975 the Nolan County Soil and Water Conservation District was organized to better serve the needs of Nolan County. Their main objectives were conserving soil and water and improving the living condition of the rural family.

Beef production is the main enterprise in the county. Livestock operations are primarily cow-calf. Sheep and goats and a few dairy cattle are also raised.

Cotton, wheat, and grain sorghums are the main crops. Much of the cropland is used to grow supplemental feed for ranching operations.

natural resources

Nolan County possesses many natural resources. Soil is the most important.

In most parts of the county water supplies are adequate for livestock and domestic uses (*3*). The water-bearing rocks that contain usable quality water include beds of Permian age, the Santa Rosa Formation of Triassic age, the Trinity and Fredricksburg Groups of Cretaceous age, the Ogallala Formation, and Quaternary gravel. The principal water-bearing units are rocks of the Santa Rosa Formation and the sand of the Trinity Group.

Mineral resources contribute an average of 33 million dollars annually to the economy of Nolan County. These revenues come from sales of oil, gas, cement, gypsum, stone, sand, and gravel. Oil production began in 1939 and averages 13,000 barrels a day. Gypsum was first mined in 1882 and was used to make plaster of paris. At present, two companies use gypsum to manufacture sheet rock for nationwide use. Large quantities of limestone are mined in the county and shipped throughout the nation. Most of the sand and gravel are used locally.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and

other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the survey area vary widely in their suitability for major land uses. Table 4 shows the extent of the map units shown on the general soil map. It lists the suitability of each, in relation to that of the other map units, for major land uses and shows soil properties that limit use. Soil ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for *cultivated crops, rangeland, urban uses,* and *recreation areas*. Cultivated crops are those grown extensively in the survey area. Rangeland refers to land in native vegetation. Urban uses include residential, commercial, and industrial developments. Recreation areas are campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic.

soil descriptions

1. Ector

Very shallow and shallow, undulating to hilly, moderately permeable, loamy and very gravelly soils

These soils are on broad ridgetops, plateaus, hillsides, plains, and foot slopes. They formed in material derived from Cretaceous limestone bedrock.

This map unit makes up about 43 percent of the county. Ector soils make up about 55 percent of the unit, and minor soils and Rock outcrop make up the remaining 45 percent.

The Ector soils typically are dark brown very gravelly clay loam about 12 inches thick over fractured limestone bedrock.

Minor soils in this unit are in the Gageby, Kavett, Lozier, Mereta, Tarrant, Tobosa, and Volente series. Gageby and Volente soils are on narrow flood plains and in valleys. The Kavett, Mereta, and Tarrant soils are gently sloping and are on ridges. The Lozier soils are on steep escarpments. The Tobosa soils are nearly level and gently sloping and are on divides.

This unit is mainly rangeland. A few of the minor soils are cropland.

This map unit is poorly suited to crops. The undulating to hilly slopes, shallow rooting depth, and the water erosion hazard restrict its use to rangeland. Low rainfall, very low available water capacity, and shallow rooting depth limit the amount of forage produced during most years. Because this unit supports a wide variety of plants, there is a good balance of forage for year-round grazing. Native range plants are mainly short and mid grasses. Forbs and shrubs are abundant. This unit furnishes habitat for most kinds of wildlife in the survey area.

This unit is poorly suited to most urban development. Although the terrain is rough, it includes many scenic areas that are desirable as homesites. Slope and depth to limestone bedrock are the most limiting features. This unit is poorly suited to recreational uses. The slope and small stones on the surface restrict its use.

2. Potter-Veal-Mereta

Very shallow, shallow, and deep, nearly level to hilly, moderately permeable to moderately slowly permeable, loamy and gravelly soils

These soils are on narrow ridgetops, hillsides, and foot slopes. They formed in loamy material and caliche of the Ogallala Formation deposited during the Pliocene Epoch.

This map unit makes up about 15 percent of the county. Potter soils make up about 28 percent of the unit, Veal soils about 16 percent, Mereta soils about 14 percent, and minor soils make up the remaining 42 percent.

The Potter soils are gently undulating to hilly and are on uplands. Typically, these soils are grayish brown gravelly loam about 5 inches thick overlying a layer of white platy caliche about 7 inches thick. The underlying material is massive, white, limy earth several feet thick.

The Veal soils are gently sloping and are on uplands. Typically, these soils have a surface layer of calcareous, brown loam about 10 inches thick. The upper part of the subsoil is calcareous, brownish clay loam that is 25 to 50 percent carbonates. The lower part of the subsoil is whitish calcareous loam.

The Mereta soils are nearly level and gently sloping and are on uplands. Typically, these soils are brown, calcareous clay loam about 18 inches thick. The underlying material is a 4 inch layer of pink, strongly cemented caliche that grades to pink loam that is mostly carbonates.

Minor soils in this unit are in the Colorado, Ector, Nipsum, Shep, and Spade series. Colorado soils are on narrow flood plains. The Ector soils are undulating to hilly and are on uplands. The Nipsum and Shep soils are nearly level to strongly sloping and are on foot slopes in broad valleys. The Spade soils are gently sloping and are on ridges.

This unit is mainly rangeland. Some small areas may be cultivated.

The soils of this map unit are poorly suited to crops. Some of the less sloping areas of Mereta and Veal soils are moderately well suited. Slopes, shallow depth, moderate to very low available water capacity, and the water erosion hazard restrict the use of this unit mainly to rangeland. Small grains and forage sorghums are the main cultivated crops.

This unit is moderately well suited to rangeland. Low rainfall, medium to very low available water capacity, and shallow rooting depth limit the amount of forage produced during most years. Native range plants are short and mid grasses. Deer, turkey, and quail are abundant on this unit. A wide variety of grasses, forbs, and shrubs offer wildlife year-round food and cover. There are some springs along the creeks that drain the area.

This unit is moderately well suited to most urban and recreational uses. Slope, shallow depth to rock, and small stones are the most limiting features for urban development. Slope and small stones on the surface are restrictions for camp areas and playgrounds.

3. Woodward-Quinlan-Burson

Very shallow to moderately deep, gently sloping to hilly, moderately permeable, loamy soils

These soils are on highly dissected knolls, ridges, steep-sided draws, creeks, and gullies. They formed in silty and loamy red beds deposited during the Permian Period.

This map unit makes up about 13 percent of the county. Woodward soils make up about 28 percent of the unit, Quinlan soils about 23 percent, Burson soils about 13 percent, and minor soils make up the remaining 36 percent.

The Woodward soils are gently sloping and are on uplands. Typically, these soils are calcareous, reddish brown loam to a depth of about 31 inches. The underlying material is weakly cemented, calcareous sandstone.

The Quinlan soils are gently sloping to strongly sloping and are on uplands. Typically, these soils are calcareous, reddish brown loam to a depth of about 13 inches. The underlying layer is yellowish red, weakly cemented, calcareous sandstone.

Burson soils are on hills and ridges. Typically, these soils are calcareous, red loam about 7 inches thick. The underlying layer is red, weakly cemented sandstone that is calcareous and interbedded with silty and sandy materials.

Minor soils in this unit are in the Acme, Cottonwood, Colorado, Paducah, and Texroy series. The Acme and Cottonwood soils are gently sloping. They formed in gypsum and are on ridges. Colorado soils are on narrow flood plains. The Paducah soils are gently sloping and are on uplands. The Texroy soils are nearly level and are on upland plains and terraces.

This unit is used mainly as rangeland. Some areas of the Woodward soils are cultivated.

The soils of this map unit are poorly suited to crops. Slope, low to very low available water capacity, shallow rooting depth, and the water erosion hazard limit their use for cultivated crops. Where the soils are cultivated, small grains and forage sorghum are the main crops.

This unit is moderately well suited to rangeland. Low rainfall, low to very low available water capacity, and restricted rooting depth limit the amount of forage produced during most years. Native range plants are short and mid grasses. Potential for wildlife habitat in general is fair and for quail is good.

This unit is poorly suited to most urban and recreational development. Slope and depth to sandstone are the most limiting features.

4. Rowena

Deep, nearly level to gently sloping, moderately slowly permeable, loamy soils

These soils are on broad, smooth plains. They formed in calcareous clay loam and clay sediments derived from rocks of the Ogallala Formation.

This map unit makes up about 10 percent of the county. Rowena soils make up about 72 percent of the unit, and minor soils make up the remaining 28 percent.

Typically, these Rowena soils have a surface layer of dark brown clay loam about 12 inches thick. The next layer to about 38 inches is calcareous, brownish clay. The underlying layer is pink to reddish yellow clay loam that has common to many masses of calcium carbonate.

Minor soils in this unit are in the Gageby, Mereta, Randall, Roscoe, and Veal series. Gageby soils are on narrow flood plains. Mereta soils are on low ridges. Randall and Roscoe soils are in playa lakes and drainageways. The Veal soils are gently sloping and are generally on outer edges of this map unit.

This map unit is used almost exclusively for cultivated crops. A few areas are used as rangeland or pasture.

The soils of this unit are well suited to crops. Cotton, grain sorghum, and small grains are the main crops. Most of the cotton and grain produced in the county are grown on this unit.

This unit is well suited to rangeland, although low rainfall limits yields in some years. Native range plants are short and mid grasses. Potential for wildlife habitat is good, but most of the plants grow along fence rows and in small plots. Playas furnish feed and resting places for migratory ducks and geese in wet years.

This unit is poorly suited to most urban uses. Shrinking and swelling, corrosivity to uncoated steel, and moderately slow permeability are the most limiting features. Low soil strength is an additional feature that affects construction of roads and streets. The map unit is moderately well suited to recreational uses—moderately slow permeability is the most limiting feature.

5. Sagerton-Rotan-Cobb

Deep and moderately deep, nearly level to gently sloping, moderately permeable to moderately slowly permeable, loamy soils

These soils are on broad outwash plains. They formed in calcareous loamy sediments of the Quaternary Period.

This map unit makes up about 9 percent of the county. Sagerton soils make up about 40 percent of the unit, Rotan soils about 11 percent, Cobb soils about 7 percent, and minor soils make up the remaining 42 percent.

The Sagerton soils are nearly level to gently sloping and are on broad uplands. Typically, the surface layer is brown clay loam about 10 inches thick. The next layer, to a depth of about 53 inches, is brownish to reddish clay. The underlying layer to about 68 inches is light red clay loam that is about 20 percent calcium carbonate.

The Rotan soils are nearly level and gently sloping and are on uplands. The surface layer is brownish clay loam about 15 inches thick. The next layer, to a depth of about 30 inches, is brownish clay. The underlying layer to a depth of about 66 inches is reddish yellow clay loam that is about 20 percent calcium carbonate.

The Cobb soils are gently sloping and are on uplands. Typically, the surface layer is reddish brown fine sandy loam about 7 inches thick. The next layer, which extends to a depth of about 38 inches, is brownish to reddish sandy clay loam. The underlying layer is red, weakly cemented sandstone.

Minor soils in this unit are in the Cosh, Gageby, Miles, Nipsum, and Spade series. The Cosh, Miles, and Spade soils are nearly level to gently sloping and are on uplands. Gageby soils are on narrow flood plains. The Nipsum soils are nearly level and gently sloping and are in valleys.

This unit is used mainly for cultivated crops. A few areas are used as rangeland.

The soils of this unit are well suited to crops. Cotton, small grains, and grain sorghum are the main crops. Supplemental irrigation is used in some areas.

This unit is well suited to rangeland, although low rainfall limits yields during some years. Native range grasses are mainly short and mid grasses.

This unit is moderately well suited to most urban uses. Shrinking and swelling, corrosivity to uncoated steel, and moderately slow permeability are the most limiting features. Low soil strength also affects construction of roads and streets. This map unit is well suited to recreational uses.

6. Tobosa-Kavett

Deep and shallow, nearly level to gently sloping, very slowly permeable and moderately slowly permeable, clayey soils

These soils are on broad divides. They formed in sediments weathered from limestone bedrock of the Cretaceous Period.

This map unit makes up about 6 percent of the county. Tobosa soils make up about 36 percent of the unit, Kavett soils about 20 percent, and minor soils make up the remaining 44 percent.

Typically, the Tobosa soils are brownish, calcareous clay to a depth of about 64 inches.

Typically, the Kavett soils are brownish, calcareous clay to a depth of about 16 inches. The underlying layer is about 3 inches of white, hard caliche plates on indurated fractured limestone.

Minor soils in this unit are in the Ector, Gageby, Mereta, Nipsum, Roscoe, Rowena, Speck, and Tarrant series. Ector, Mereta, Speck, and Tarrant soils are on ridgetops. Gageby soils are on narrow flood plains. The Nipsum soils are nearly level to gently sloping and are on foot slopes and in valleys. The Roscoe soils are nearly level and are in depressional areas and drainageways. The Rowena soils are nearly level and gently sloping and are on uplands.

This unit is used mainly for cultivated crops. Some areas are used as rangeland.

The soils of this unit are moderately well suited to crops. Cotton, grain sorghum, and small grains are the main crops. Clayey textures and droughtiness are the main limitations for this use.

This unit is moderately well suited to rangeland. Native range plants are mainly short and mid grasses. The encroachment of mesquite is a severe problem. The very low available water capacity of the Kavett soil is a limiting feature. The potential of this unit for wildlife habitat is medium. Deer and turkey feed on the forbs and grasses of these productive soils, especially during the growing season. Small grain fields are also utilized by deer.

These soils are poorly suited to most urban and recreational uses. Depth to bedrock, shrinking and swelling, corrosivity to uncoated steel, low strength

affecting roads and streets, and very slow permeability are the most limiting features for urban development. Very slow permeability and clayey texture of the surface layer are the most limiting features for recreational development.

7. Latom-Cobb-Rock outcrop

Very shallow to moderately deep, nearly level to rolling, moderately permeable, loamy soils and Rock outcrop

These soils are on erosional uplands. They formed mainly in materials weathered from calcareous, red-bed sandstone of the Triassic Period.

This unit makes up about 4 percent of the county. Latom soils make up about 20 percent of the unit, Cobb soils about 20 percent, Rock outcrop about 12 percent, and minor soils make up the remaining 48 percent.

The Latom soils are rolling and are on uplands. Typically these soils are reddish brown fine sandy loam about 5 inches thick over strongly cemented sandstone bedrock.

The Cobb soils are nearly level to gently sloping and are on uplands. Typically, the surface layer is reddish brown fine sandy loam about 7 inches thick. The next layer, to a depth of about 38 inches, is sandy clay loam that is reddish brown in the upper part and red in the lower part. The underlying layer is red sandstone.

Rock outcrop consists of small areas of exposed strongly cemented bedrock. These areas are generally closely associated with the Latom soils.

Minor soils in this unit are in the Colorado, Cosh, Miles, and Spade series. Colorado soils are on narrow flood plains. The Cosh, Miles, and Spade soils are nearly level to gently sloping and are on ridges and plains.

This unit is mainly rangeland. A few areas of Cobb soils and some of the minor soils are cultivated.

The soils of this unit are poorly suited to crops. Slope, Rock outcrop, and shallow rooting depth restrict cultivation. Small grains and forage sorghum are the main crops.

This unit is poorly suited as rangeland. Rapid runoff, low available water capacity, Rock outcrop, and shallow rooting depth are limiting features. Native range plants are mainly mid and short grasses. Wildlife is not abundant on this map unit, however, the sandstone escarpments and ledges provide cover for many animals.

This soil is poorly suited to most urban and recreational development. Slope, depth to sandstone and bedrock, and Rock outcrop are the most limiting features.

broad land use considerations

The soils of Nolan County vary widely in their potential for major land uses, as indicated in table 4. For each land use, this table indicates general ratings of the potential of each unit of the general soil map in relation to the other map units. Kinds of soil limitations are also indicated in general terms. These ratings of soil potential reflect the relative cost of several land use practices and the hazard of continued soil-related problems after such practices have been installed. The ratings do not consider location in relation to existing transportation systems or to other kinds of facilities.

The land uses considered include cultivated crops, rangeland, and urban and recreational uses. Cultivated crops grown in the county include cotton, grain sorghum, and wheat. Rangeland refers to land in native vegetation. Urban uses include land developed for residential, commercial, and industrial sites. Recreation areas include nature study areas, paths and trails, picnic areas, camp areas, and playgrounds.

In general, the agricultural economy is the most important factor influencing land use in the county.

About 71 percent of the county is rangeland and about 24 percent is used for cultivated crops. According to table 4, however, about 19 percent of the county is well suited to rangeland, about 34 percent is moderately well suited, and 47 percent produces low amounts of forage. Table 4 also indicates that about 19 percent of the county is well suited to cultivated crops, 6 percent is moderately well suited, and 75 percent is poorly suited or not suited to cultivation.

The trend in recent years has been an almost stable land use. About the same number of acres are converted each year from rangeland to cropland as are converted from cropland to grassland. There has been a slight increase in the number of acres used for urban development.

In general, the Rowena and the Sagerton-Rotan-Cobb map units have high potential for cultivated crops and also for rangeland. These units include deep, loamy soils that are well suited to both uses. They require good managment, however, to prevent damage from water erosion and soil blowing. In addition, they require good design and installation procedures when used for urban development. The main problems are shrinking and swelling and corrosivity. Low strength is a limitation for local roads and streets. The shallow or very shallow loamy soils of the Ector and Potter-Veal-Mereta map units are poorly suited to most uses. Slope, the water erosion hazard, small stones on the surface, and depth to indurated caliche or limestone bedrock are limitations to their use.

The general soils information in this section and more detailed information in the following sections can be used as a guide in planning the orderly growth and development of the county. This information is especially helpful in determining which soils to allocate to each use.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses. It includes a discussion of rangeland management that gives the potential plant community; that is, the native and introduced plants best adapted to the soil.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Miles loamy fine sand, 0 to 3 percent slopes, is one of several phases in the Miles series.

Some map units are made up of two or more major soils. These map units are called soil complexes or soil associations.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Volente-Gageby complex, 0 to 5 percent slopes, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Quinlan-Burson-Woodward association, rolling, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 5 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

1—Acme-Cottonwood complex, 1 to 5 percent slopes. The soils in this complex are shallow and very shallow. They are gently sloping and are on uplands. Slopes average about 3 percent. Soil areas are oblong to irregularly shaped and range from 50 to 180 acres.

These soils are so intricately mixed that it is not practical to map them separately at the scale used. The complex is about 42 percent Acme soils, 28 percent Cottonwood soils, and 30 percent other soils and land types. Cottonwood soils are typically slightly higher on the landscape than the Acme soils.

Typically, the Acme soil is brown, calcareous, moderately alkaline loam about 18 inches thick. It rests abruptly on soft, white gypsum, which extends to a depth of more than 30 inches.

Typically, the Cottonwood soil is reddish brown, calcareous, moderately alkaline loam about 8 inches thick. It rests abruptly on soft, white gypsum (fig. 1).

Both soils in this complex are well drained. Surface runoff is slow to rapid. Permeability is moderate, and the available water capacity is very low. The hazards of water erosion and soil blowing are moderate.

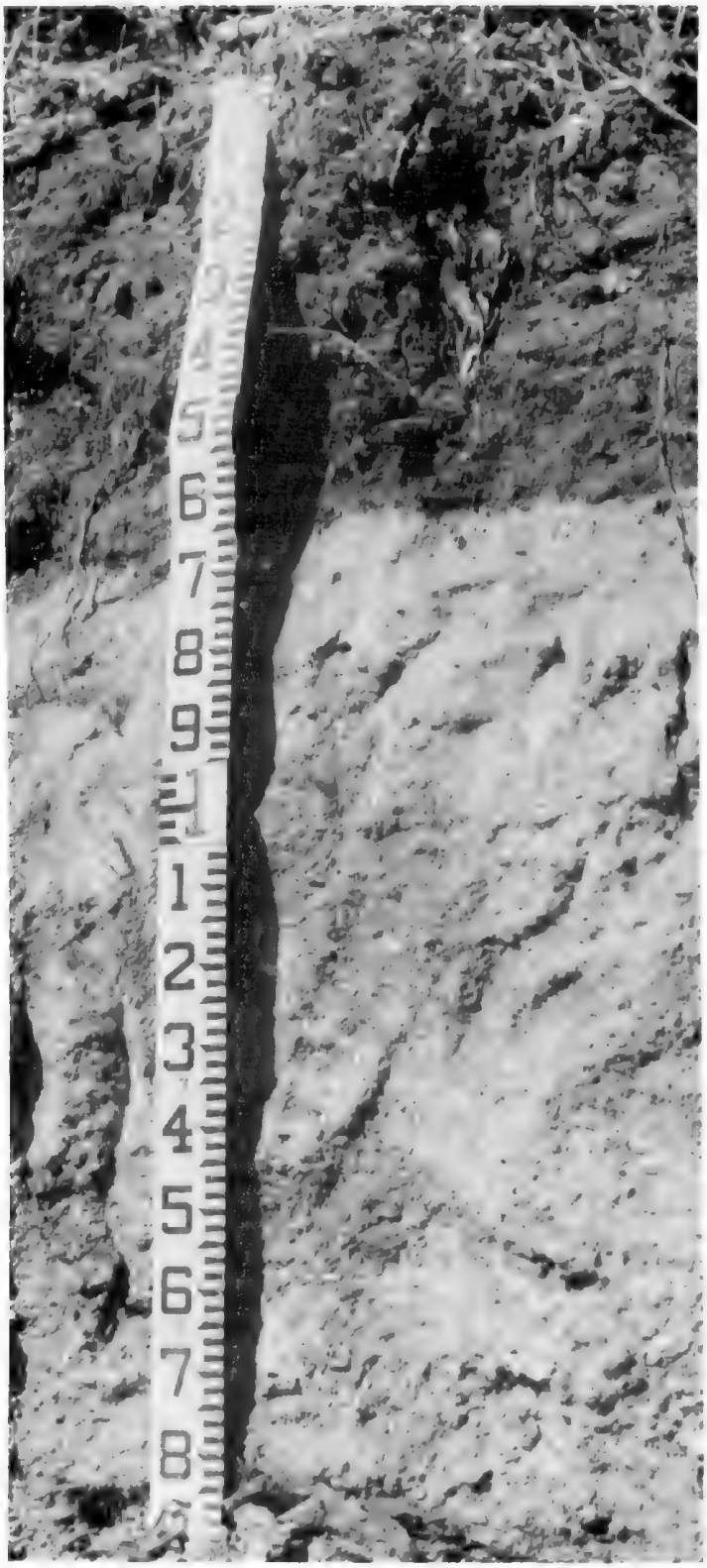


Figure 1.—Profile of Cottonwood loam in an area of Acme-Cottonwood complex, 1 to 5 percent slopes, showing soft gypsum at 6 inches.

Included in mapping this complex are small areas of Woodward and Quinlan soils and areas of gypsum bedrock that are bare or are covered with less than 3 inches of soil. Also included are a few areas of a soil that is more than 20 inches thick over gypsum. Included soils make up 30 percent or less of a mapped area.

These Acme and Cottonwood soils are mainly rangeland, but a few areas are cultivated. Small grains and forage sorghums are the main crops.

The soils in this complex are poorly suited to small grains or forage sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also control water erosion.

These soils are poorly suited to most urban and recreational uses. Depth to rock is the most restrictive feature.

Where the Acme soil is used as rangeland, the potential plant community is a short to mid grass prairie with scattered browse. Typically, sideoats grama, buffalograss, tobosa, and vine-mesquite make up 75 percent of the total vegetation. Arizona cottontop, silver bluestem, white tridens, Texas wintergrass, and sand dropseed make up about 15 percent. The rest is forbs, such as dotted gayfeather, milkvetch, and gaura, and woody plants, such as lotebush, agarito, ephedra, and wolfberry.

As the range deteriorates as a result of heavy grazing sideoats grama and vine-mesquite are replaced mostly by tobosa and buffalograss. Upon further deterioration, buffalograss decreases and mesquite and pricklypear invade the site. Annual forbs along with red grama, purple threeawn, and hairy tridens eventually make up most of the vegetation.

Where the Cottonwood soil is used as rangeland, the potential plant community is mainly mid grasses. Typically, sideoats grama makes up about 20 percent of the total. Tall grasses, such as indiangrass, sand bluestem, and little bluestem, make up 20 percent. The rest is grasses, such as plains bristlegrass, Arizona cottontop, vine-mesquite, buffalograss, hairy grama, slim and rough tridens, reverchon bristlegrass, black grama, cane and silver bluestem, sand dropseed, tobosa, and perennial threeawn; forbs, such as buckwheat, greenthread, false broomweed, gray goldaster, dotted gayfeather, plains blackfoot, plains zinnia, broom snakeweed, rabbitbrush, mallows, and eveningprimrose; and woody plants, such as littleleaf sumac, skunkbush sumac, hackberry, bumelia, elbowbush, vine ephedra, bush honeysuckle, feather dalea, catclaw, and redberry juniper.

As the range deteriorates, the tall grasses and palatable forbs decrease. They are replaced by buffalograss, threeawn, hairy grama, and rough tridens. Further heavy grazing leads to an invasion of red grama,

hairy tridens, threeawn, annual grasses, annual forbs, pricklypear, and mesquite.

Deer and quail use this complex occasionally, but numbers are limited because of inadequate cover and forage. This complex produces fair habitat for quail in the form of annual seed plants.

This complex is in capability subclass IVe. The Acme soil is in the Clay Loam range site, and the Cottonwood soil is in the Gyp range site.

2—Burson-Quinlan association, hilly. The soils in this association are very shallow and shallow. They are hilly and on uplands. Slopes range from 10 to 25 percent, but average about 12 percent. Soil areas are oval and range from 30 to 280 acres.

This association is more variable in composition than most other map units in the county. Mapping has been controlled well enough, however, for the anticipated use of the areas involved. This association is 60 to 70 percent Burson soils and 20 to 30 percent Quinlan soils. The other 10 to 20 percent is Woodward soils, Pitzer soils, badlands, and sandstone outcrops.

Typically, the Burson soil is red, calcareous, moderately alkaline loam about 7 inches thick. It rests on red, weakly cemented sandstone, which is several feet thick.

Typically, the Quinlan soil has a surface layer of reddish brown loam about 6 inches thick. The subsoil is yellowish red loam about 7 inches thick. The underlying material is yellowish red, weakly cemented sandstone. This soil is calcareous and moderately alkaline throughout.

Both soils are well drained to excessively drained. Surface runoff is rapid to very rapid. Permeability is moderate, and the available water capacity is very low. The hazard of water erosion is severe, and the hazard of wind erosion is slight to moderate.

The soils in this association are not suitable for cultivation because of slope, the shallow and very shallow rooting depth, and susceptibility to water erosion. They are mainly rangeland.

These soils are poorly suited to most urban and recreational uses. Slope and depth to rock are the most limiting features.

Where the Burson soil is used as rangeland, the potential plant community is a mixture of tall, mid, and short grasses and a good variety of forbs and woody species. Sideoats grama makes up about 15 percent of this plant community, and indiangrass, big bluestem, and little bluestem together make up about 20 percent. The rest is grasses, such as black grama, cane and silver bluestem, hairy grama, buffalograss, curlymesquite, blue grama, slim and rough tridens, threeawn, fall witchgrass, Texas wintergrass, and New Mexico feathergrass; forbs, such as dotted gayfeather, rockdaisy, prairie-clover, gaura, bushsunflower, trailing ratany, eveningprimrose, Indian mallow, penstemon, dalea, white sage, and catclaw sensitivebrier; and woody plants, such as littleleaf sumac, skunkbush sumac, vine ephedra, catclaw acacia, wolfberry, agarito, javalinabush, redberry juniper, yucca, and greenbrier.

As the range deteriorates, tall grasses and palatable forbs are replaced by buffalograss, threeawn, slim and rough tridens, and feathery bluestem. Further deterioration leads to an invasion of threeawn, hairy tridens, broom snakeweed, and annual forbs.

Where the Quinlan soil is used as rangeland, the potential plant community consists of mid and short grasses and a variety of forbs and woody species. Blue grama, buffalograss, and curlymesquite make up about 35 percent of the climax plant community. Sideoats grama makes up 15 percent; plains bristlegrass, vine-mesquite, Arizona cottontop, and little bluestem make up 20 percent; and hairy grama, cane and silver bluestem, sand dropseed, hooded windmillgrass, black grama, and purple and Wright threeawns make up about 15 percent. The rest is cool-season grasses, such as Texas wintergrass, Canada wildrye, Hall panicum, and fall witchgrass; forbs, such as Engelmann-daisy, Maximilian sunflower, heath aster, trailing ratany, bundleflower, catclaw sensitivebrier, gaura, prairie-clover, wild alfalfa, sagewort, dotted gayfeather, skeletonplant, buckwheat, and groundcherry; and woody plants, such as littleleaf sumac, skunkbush sumac, bumelia, elbowbush, hackberry, dalea, fourwing saltbush, vine ephedra, agarito, wolfberry, catclaw acacia, yucca, and juniper.

As deterioration as a result of heavy grazing occurs, sideoats grama is replaced by buffalograss, sand dropseed, and threeawn. Further heavy grazing leads to an invasion of hairy tridens, red grama, sand muhly, mesquite, juniper, pricklypear, yucca, and tasajilla.

This association is used heavily by deer, dove, and quail. Ground-nesting birds also frequent the site. The plant varieties provide limited food and cover for wildlife.

The Burson soils are in capability subclass VIIs and the Very Shallow range site. The Quinlan soils are in capability subclass VIe and the Loamy Prairie range site.

3—Cobb fine sandy loam, 1 to 5 percent slopes. This is a moderately deep, gently sloping soil on upland plains. Slopes average about 2.5 percent. Soil areas are irregularly shaped and range from 25 to 200 acres.

Typically, this soil has a surface layer of neutral, reddish brown fine sandy loam about 7 inches thick. The subsoil extends to a depth of about 38 inches. The upper part is neutral, reddish brown sandy clay loam about 9 inches thick. The lower part is moderately alkaline, red sandy clay loam. The underlying material is red, weakly cemented sandstone.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water capacity is low. The rooting zone is moderately deep and easily penetrated by plant roots. The hazards of water erosion and soil blowing are moderate.

Included in mapping are small areas of Cosh, Miles, and Spade soils and some small areas of nearly level

Cobb soil. These included soils make up as much as 20 percent of a mapped area.

This soil is mainly rangeland, but a few areas are cultivated. Small grains and forage sorghum are the main crops.

This Cobb soil is moderately well suited to small grains or forage sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing. They also conserve moisture by lowering evaporation from the soil. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also control water erosion.

This soil is moderately well suited to most urban uses. Depth to rock is the most restrictive feature. The soil is well suited to most recreational uses.

On rangeland the potential plant community is primarily mid grasses. Typically, sideoats grama and buffalograss make up about 40 percent of this plant community, and little bluestem, plains bristlegrass, Arizona cottontop, and vine-mesquite make up about 40 percent. The rest is grasses, such as sand dropseed, hooded windmillgrass, hairy grama, silver bluestem, fall witchgrass, plains lovegrass, and Wright threeawn; forbs, such as catclaw sensitivebrier, halfshrub eveningprimrose, trailing ratany, Engelmann-daisy, gaura, sagewort, dotted gayfeather, western ragweed, and heath aster; and woody plants, such as yucca, catclaw, agarito, hackberry, skunkbush sumac, bumelia, littleleaf sumac, and sagebrush.

As the range deteriorates as the result of heavy grazing, sideoats grama and little bluestem are replaced by threeawn, sand dropseed, and buffalograss. Eventually plants such as mesquite trees, pricklypear, condalia, and numerous annuals invade the site.

This soil is used for wildlife habitat. Quail and dove frequent the area because of the abundance of seed plants. The use of some areas for playgrounds is restricted by depth to rock and slope.

This Cobb soil is in capability subclass IIIe and the Sandy Loam range site.

4—Cobb-Miles complex, 0 to 1 percent slopes. The soils in this complex are moderately deep and deep. They are nearly level and on uplands. Slopes average about 0.5 percent. Soil areas are oblong to irregularly shaped and range from 20 to 200 acres.

This complex is 50 to 65 percent Cobb soils, 15 to 20 percent Miles soils, and 15 to 30 percent Cosh and Spade soils. These soils are so intricately mixed that it is not practical to map them separately at the scale used.

Typically, the Cobb soil has a surface layer of neutral, reddish brown fine sandy loam about 7 inches thick. The subsoil is neutral sandy clay loam about 31 inches thick. It is reddish brown in the upper 9 inches and red in the lower part. The underlying material is weakly cemented sandstone.

Typically, the Miles soil has a surface layer of neutral, reddish brown fine sandy loam about 10 inches thick. The subsoil extends to a depth of about 52 inches. It is mildly alkaline sandy clay loam that is reddish brown in the upper part and yellowish red in the lower part. The underlying material to a depth of about 63 inches is pink moderately alkaline, calcareous sandy clay loam. It is about 10 percent, by volume, soft masses of calcium carbonate.

These soils are well drained. Surface runoff is slow. Permeability is moderate. The hazard of water erosion is slight and the hazard of soil blowing is moderate.

These soils are mainly cropland, but a few areas are rangeland. Cotton and grain sorghum are the main crops.

These soils are well suited to cotton or grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and also to conserve moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, diversion terraces, and grassed waterways also control water erosion.

These soils are well suited to most urban and recreational uses. Seepage is the most restrictive feature, but this can be easily overcome by careful installation procedures. Low soil strength is a limitation for local roads and streets.

Where this complex is in rangeland, the potential plant community is primarily mid grasses. Typically, sideoats grama and buffalograss make up about 40 percent of the vegetation. Little bluestem, plains bristlegrass, Arizona cottontop, and vine-mesquite make up another 40 percent. The rest is grasses, such as sand dropseed, hooded windmillgrass, hairy grama, silver bluestem, fall witchgrass, plains lovegrass, and Wright threeawn; forbs, such as catclaw sensitivebrier, halfshrub eveningprimrose, trailing ratany, Engelmann-daisy, gaura, sagewort, dotted gayfeather, western ragweed, and heath aster; and woody plants, such as yucca, catclaw, agarito, hackberry, skunkbush sumac, bumelia, littleleaf sumac, and sand sagebrush.

As the range deteriorates as a result of heavy grazing, sideoats grama and little bluestem are grazed out and replaced by threeawn, sand dropseed, and buffalograss. Eventually plants such as mesquite trees, pricklypear, condalia, and numerous annuals invade the site.

If this complex is used for wildlife habitat, quail and dove frequent the area because of the abundance of seed plants.

This Cobb-Miles complex is in capability subclass IIe and the Sandy Loam range site.

5—Cobb-Miles complex, 1 to 3 percent slopes. The soils in this complex are moderately deep and deep. They are on uplands. Slopes average about 1.5 percent. Soil areas are oblong to irregularly shaped and range from about 50 to 400 acres.

This complex is about 60 percent Cobb soils, 20 percent Miles soils, and 20 percent other soils. These

soils are so intricately mixed that it is not practical to map them separately at the scale used.

Typically, the Cobb soil has a surface layer of neutral, reddish brown fine sandy loam about 6 inches thick. The subsoil is neutral sandy clay loam about 32 inches thick. It is reddish brown in the upper part and red in the lower part. The underlying material is moderately alkaline, weakly cemented sandstone.

Typically, the Miles soil has a surface layer of neutral, reddish brown fine sandy loam about 4 inches thick. The subsoil is mildly alkaline sandy clay loam about 48 inches thick. It is reddish brown in the upper 20 inches and yellowish red in the lower 28 inches. The underlying material is pink, moderately alkaline, calcareous sandy clay loam that is about 15 percent, by volume, soft masses of calcium carbonate.

Included in mapping are some areas of Cosh and Spade soils and some soils that are like Cobb soil but are more than 40 inches deep to sandstone. Also included are a few areas of Cobb and Miles soils that are nearly level or have slopes of more than 3 percent and some areas of eroded soils that have a thinner surface layer.

The soils in this complex are well drained. Surface runoff is medium. Permeability is moderate. The hazards of water erosion and soil blowing are moderate.

These soils are mainly cropland, but a few areas are rangeland. Cotton and grain sorghum are the main crops.

These soils are well suited to cotton or grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and also to conserve moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also control water erosion.

These soils are well suited to most urban and recreational uses. Seepage is the most restrictive feature, but this can be easily overcome by careful installation procedures. Low soil strength is a limitation for local roads and streets.

On rangeland the potential plant community is primarily mid grasses. Typically, sideoats grama and buffalograss make up about 40 percent of the vegetation. Little bluestem, plains bristlegrass, Arizona cottontop, and vine-mesquite make up another 40 percent. The rest is grasses, such as sand dropseed, hooded windmillgrass, hairy grama, silver bluestem, fall witchgrass, plains lovegrass, and Wright threeawn; forbs, such as catclaw sensitivebrier, halfshrub eveningprimrose, trailing ratany, Engelmann-daisy, gaura, sagewort, dotted gayfeather, western ragweed, and heath aster; and woody plants, such as yucca, catclaw, agarito, hackberry, skunkbush sumac, bumelia, littleleaf sumac, and sand sagebrush.

As the range deteriorates as a result of heavy grazing, sideoats grama and little bluestem are grazed out and replaced by threeawn, sand dropseed, and buffalograss. Eventually plants such as mesquite trees, pricklypear, condalia, and numerous annuals invade the site.

Where this complex is used for wildlife habitat, birds such as quail and dove frequent the area because of the abundance of seed plants.

This Cobb-Miles complex is in capability subclass IIIe and the Sandy Loam range site.

6—Colorado loam, occasionally flooded. This is a deep, nearly level soil on bottom land. Slopes are less than 1 percent. Soil areas are long and narrow and range from 30 to 150 acres. This soil is flooded for a period of a few hours every 2 to 7 years.

Typically, this soil is loamy throughout. It has a surface layer of reddish brown loam about 6 inches thick. The next layer is brown clay loam 12 inches thick. From about 18 to 34 inches is brown loam with films and threads of calcium carbonate in the lower part. The next layer, which extends to a depth of 52 inches, is brown sandy clay loam. The underlying material to a depth of about 70 inches is light reddish brown sandy clay loam.

This soil is well drained. Surface runoff is slow. Permeability is moderate, and the available water capacity is high. The rooting zone is deep. The hazards of water erosion and soil blowing are slight.

Included in mapping are some small areas of Texroy and Gageby soils. Also included are areas of gently sloping Colorado soils. These included soils make up as much as 20 percent of a mapped area.

This Colorado soil is mainly cropland, but a few areas are rangeland. Small grains and grain sorghums are the main crops.

This soil is moderately well suited to small grains or grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and also to conserve soil moisture. Diversion terraces and grassed waterways also control water erosion.

This soil is poorly suited to most urban uses. Flooding is the most restrictive feature. It is moderately well suited to recreational uses. Flooding and a dusty surface are limitations for this use.

On rangeland the potential plant community is dominantly tall and mid grasses and a variety of forbs and woody plants. Typically, indiangrass, switchgrass, and big bluestem make up about 25 percent of the plant community when the range is in good condition. Sideoats grama makes up about 20 percent, and mid grasses such as vine-mesquite, plains bristlegrass, Arizona cottontop, cane and silver bluestems, and white tridens make up about 25 percent. The rest is grasses, such as Texas wintergrass, Canada wildrye, western wheatgrass, and tobosa; forbs, such as Engelmann-daisy, Maximilian sunflower, heath aster, bundleflower, gaura, sagewort, prairie-clover, Indian mallow, and milkvetch; and woody plants, such as cottonwood, pecan, hackberry, bumelia, elm, western soapberry, plum, vine ephedra, elbowbush, agarito, wolfberry, greenbrier, and fourwing saltbush.

As the range deteriorates, the tall grasses are replaced by buffalograss, Texas wintergrass, tobosa, and

annual forbs. In its poorest condition, this soil produces mainly red grama, threeawn, hairy tridens, mesquite, lotebush, pricklypear, and tasajillo.

This soil provides good habitat for deer, turkey, dove, and quail. The high quality woody shrubs, tall trees, grasses, and forbs provide an abundant food supply, excellent cover for all wildlife, and nesting habitat for furbearing animals.

This Colorado soil is in capability subclass IIw and the Loamy Bottomland range site.

7—Colorado loam, frequently flooded. This is a deep bottom-land soil on flood plains of streams. Slopes range from 0 to 1 percent but average about 0.5 percent. Surfaces are variable but mostly slightly undulating because of frequent flooding. Soil areas are long and narrow and range from 10 to 300 acres. This soil is flooded one or more times annually for periods of less than 2 days.

Typically, this Colorado soil has a surface layer of reddish brown loam about 8 inches thick. Below this to a depth of about 64 inches the underlying material is light reddish brown loam and stratified reddish brown fine sandy loam and silty clay loam. This soil is calcareous and moderately alkaline throughout.

This soil is well drained. Surface runoff is slow. Permeability is moderate, and the available water capacity is high. The hazards of water erosion and soil blowing are slight.

Included in mapping are small areas of soils that are closely similar to the Colorado soil. Some of these soils have siltier underlying layers, others have sandy loam underlying layers, and some have a loamy sand surface layer. These included soils make up as much as 20 percent of a mapped area.

This Colorado soil is not suitable for cultivation because of flooding. This soil is mainly rangeland and pasture.

Flooding is the main limitation for most urban and recreational uses. Some recreational areas, however, may be dusty during periods of use.

On rangeland the potential plant community is dominantly tall and mid grasses and a variety of forbs and woody plants. Typically, indiangrass, switchgrass, and big bluestem make up about 25 percent of the plant community when the range is in good condition. Sideoats grama makes up about 20 percent, and mid grasses, such as vine-mesquite, plains bristlegrass, Arizona cottontop, cane and silver bluestem, and white tridens, make up about 25 percent. The rest is grasses, such as Texas wintergrass, Canada wildrye, western wheatgrass, and tobosa; forbs, such as Engelmann-daisy, Maximilian sunflower, heath aster, bundleflower, gaura, sagewort, prairie-clover, Indian mallow, and milkvetch; and woody plants, such as cottonwood, pecan, hackberry, bumelia, elm, western soapberry, plum, vine ephedra, elbowbush, agarito, wolfberry, greenbrier, and fourwing saltbush.

As the range deteriorates, the tall grasses are replaced by buffalograss, Texas wintergrass, tobosa, and annual forbs. In its poorest condition, this soil produces mainly red grama, threeawn, hairy tridens, mesquite, lotebush, pricklypear, and tasajillo.

This soil provides good habitat for deer, turkey, dove, and quail. The high quality woody shrubs, tall trees, grasses, and forbs provide an abundant food supply, excellent cover for all wildlife, and nesting habitat for furbearing animals.

This Colorado soil is in capability subclass Vw and the Loamy Bottomland range site.

8—Cosh fine sandy loam, 1 to 5 percent slopes. This is a shallow, gently sloping soil on uplands. Slopes average about 3 percent. Soil areas are long and narrow to oval and range from 20 to 50 acres.

Typically, this soil has a surface layer of neutral, reddish brown fine sandy loam about 5 inches thick. The subsoil is neutral, red sandy clay loam about 9 inches thick. Below this to a depth of about 24 inches the underlying material is red, weakly cemented sandstone.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water capacity is very low. The rooting zone is shallow. The hazards of erosion and soil blowing are moderate.

Included in mapping are small areas of Cobb, Miles, and Spade soils and some nearly level Cosh soil. These included soils make up as much as 20 percent of a mapped area. Some closely similar soils that are more alkaline or less red in the subsoil and underlying sandstone make up as much as 40 percent of this map unit. These soils are similar in use and management to this Cosh soil.

This soil is mainly rangeland, but a few areas are cultivated. Small grains and forage sorghum are the main crops.

This Cosh soil is poorly suited to small grains and forage sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also control water erosion.

This soil is poorly suited to most urban and recreational uses. Depth to rock is the most restrictive feature.

On rangeland the potential plant community is primarily mid grasses. Typically, sideoats grama and buffalograss make up about 40 percent of the plant community. Little bluestem, plains bristlegrass, Arizona cottontop, and vine-mesquite make up about 40 percent of the vegetation. The rest is grasses, such as sand dropseed, hooded windmillgrass, hairy grama, silver bluestem, fall witchgrass, plains lovegrass, and Wright threeawn; forbs, such as catclaw sensitivebrier, halfshrub eveningprimrose, trailing ratany, Engelmann-daisy, gaura, sagewort, dotted gayfeather, western ragweed, and heath aster; and woody plants, such as yucca, catclaw,

agarito, hackberry, skunkbush sumac, bumelia, littleleaf sumac, and sand sagebrush.

As the range deteriorates as a result of heavy grazing, sideoats grama and little bluestem are grazed out and replaced by threeawn, sand dropseed, and buffalograss. Eventually plants such as mesquite trees, pricklypear, condalia, and numerous annuals invade the site.

Where this soil is used for wildlife habitat, birds, such as quail and dove, frequent the area because of the abundance of seed plants.

This Cosh soil is in capability subclass IVe and the Sandy Loam range site.

9—Ector very gravelly clay loam, 1 to 8 percent slopes. This is a very shallow and shallow, undulating soil on uplands. Rock outcrops are common, and about 50 percent of the surface is covered with limestone fragments. Soil areas are irregularly shaped and range from 100 to several hundred acres in size.

Typically, this soil has a surface layer of moderately alkaline, calcareous, dark brown very gravelly clay loam about 12 inches thick. The next layer, about 4 inches thick, is hard fractured limestone that contains secondary carbonates between crevices and as pendants on the undersides of limestone fragments. Below a depth of 12 inches the underlying material is fractured limestone bedrock.

This soil is well drained. Surface runoff is rapid. Permeability is moderate, and the available water capacity is very low. The rooting zone is very shallow. The water erosion hazard is severe, and the soil blowing hazard is slight.

Included in mapping are small areas of Tarrant, Kavett, and Mereta soils. These included soils make up as much as 25 percent of a mapped area. Also included are small areas of rock outcrop which make up about 9 percent of the map unit.

This Ector soil is not suitable for cultivation, because it has rock fragments and a very shallow rooting depth. It is mainly rangeland (fig. 2). Low rainfall, rapid runoff, very low available water capacity, and restricted rooting depth limit the amount of forage produced.

This soil is poorly suited to most urban and recreational uses. Slope, depth to rock, and small stones are the most limiting factors.

On rangeland the potential plant community is mid and short grasses and a variety of forbs and woody species (fig. 3). Typically, sideoats grama makes up about 25 percent of the total vegetation. Cane, pinhole, and silver bluestem as well as slim and rough tridens, green sprangletop, hairy grama, and plains bristlegrass make up 30 percent of the vegetation; buffalograss and curlymesquite make up about 10 percent; and reverchon bristlegrass, fall witchgrass, and bush muhly, make up about 15 percent. The rest is grasses, such as little bluestem and purple and Wright threeawns; forbs that include bushsunflower, orange zexmenia, bundleflower, croton, snoutbean, catclaw sensitivebrier, sida, chalkhill wollywhite, gaura, greenthread, verbena, primrose, and hairy tubetongue; and woody plants that include vine ephedra, shin oak, live oak, juniper, daleas, catclaw acacia, sticky selloa, pricklypear, and tasajillo.

As the plant community deteriorates as a result of heavy grazing, sideoats grama, green sprangletop, and little bluestem decrease and buffalograss, feathery bluestem, and threeawn replace them. Continued heavy grazing leads to a dominance of buffalograss and low quality perennial and annual plants. And finally, when this soil is severely overgrazed, the dominant plants are shin oak, juniper, catclaw, lotebush, agarito, pricklypear, tasajillo, broom snakeweed, pepperweed, croton, gaillardia, dozedaisy, bladderpod, red grama, hairy tridens, annual lovegrass, and threeawn.

Deer, turkey, dove, and quail inhabit this site. Cover is adequate, and the browse, forbs, and grasses furnish a year-round food supply.

This Ector soil is in capability subclass VIIs and the Limestone Hills range site.

10—Ector-Rock outcrop association, hilly. This association is on uplands. It consists of very shallow and shallow, hilly soil intermingled with Rock outcrop. It is about 46 percent Ector soil, 24 percent Rock outcrop, and 30 percent other soils. About 50 percent of the Ector soil is covered with limestone fragments. Slopes range from 8 to 20 percent and average about 15 percent. Areas of the association are irregular in shape and range from 80 to several hundred acres in size.

This association is more variable in composition than other map units in the county. Mapping has been controlled well enough, however, for the anticipated use of the areas involved.

Typically, the Ector soil has a surface layer of calcareous, moderately alkaline, dark grayish brown very gravelly clay loam about 6 inches thick. The next layer, about 4 inches thick, is hard fractured limestone that has secondary carbonates as coatings between crevices and as pendants on the underside of limestone fragments. Below a depth of 10 inches the underlying material is hard fractured limestone.

The Ector soil is well drained. Surface runoff is very rapid. Permeability is moderate, and the available water capacity is very low. The hazard of water erosion is severe, and the hazard of soil blowing is slight.

Rock outcrop consists of exposures of limestone bedrock. They are mostly limestone ledges along hillsides. Included in mapping this association are small areas of Tarrant soils and areas of limestone covered with less than 3 inches of soil. Also included are a few areas of gently sloping and sloping Ector soils. Included soils make up 30 percent or less of any one mapped area.

The soils in this association are not suitable for cultivation because they are hilly and stony and have a very shallow rooting depth. These soils are mainly rangeland. Low rainfall, rapid runoff, very low available

Figure 2.—Bulldozed trees on Ector very gravelly clay loam, 1 to 8 percent slopes, with areas of Volente-Gageby complex, 0 to 5 percent slopes, left in brush for wildlife.

water capacity, and restricted rooting depth limit the amount of forage produced.

This association is poorly suited to most urban and recreational uses. Slope, depth to rock, and small stones are the most limiting features.

On rangeland the potential plant community is mid grasses, scattered tall grasses, and a variety of forbs and woody plants (fig. 4). Typically, sideoats grama and little bluestem are the dominant grasses. Each makes up about 20 percent of the total vegetation. The rest includes such grasses as the feathery bluestems, green sprangletop, indiangrass, plains lovegrass, Texas cupgrass, tall and hairy dropseed, Canada wildrye, Texas wintergrass, fall witchgrass, slim and rough tridens, tall and hairy grama, perennial threeawn, and sedges; forbs, such as Engelmann-daisy, bushsunflower, orange zexenia, bundleflower, gaura, dozedaisy, eveningprimrose, halfshrub sundrop, and catclaw sensitivebrier; and woody plants, such as live oak, shin oak, ashe juniper, kidneywood, hackberry, redbud, grape, cacti, yucca, Lindheimer silktassel, and sumac.

As the range deteriorates as the result of heavy grazing, woody plants increase and the better grasses are replaced by hairy tridens, red grama, Texas grama, and annual forbs. In some places, juniper dominates the site.

The soils of this association provide a stand of mixed woody vegetation which is used as food and cover by deer and turkey. Steep, rocky slopes furnish shelter for many furbearing animals.

This association is in capability subclass VIIs and the Steep Rocky range site.

11—Gageby clay loam, occasionally flooded. This is a deep, nearly level soil on bottom land. Slopes average about 0.5 percent, but range from 0 to 1 percent. Soil areas are long and narrow and range from 10 to 200 acres. This soil may be flooded for a period of less than 2 days every 2 to 7 years.

Typically, the surface layer is clay loam about 31 inches thick. It is dark grayish brown to a depth of 12

Figure 3.—Landscape of Ector very gravelly clay loam, 1 to 8 percent slopes, in good range condition.

Figure 4.—Landscape of Steep Rocky range site. Soils are Ector-Rock outcrop association, hilly.

inches and dark brown to a depth of about 31 inches. The subsoil, which extends to a depth of 44 inches, is dark grayish brown clay loam. The underlying material to a depth of 64 inches is yellowish brown fine sandy loam. This soil is calcareous and moderately alkaline throughout.

This soil is well drained. Surface runoff is slow. Permeability is moderate, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazards of erosion and soil blowing are slight.

Included in mapping are small areas of Colorado and Nipsum soils. Also included are closely similar soils that are more than 35 percent clay. These included soils make up as much as 20 percent of a mapped area.

This Gageby soil is mainly cropland. Cotton, small grains, and grain sorghums are the main crops. A few areas are rangeland.

This soil is well suited to cotton, small grains, and grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Diversion terraces and grassed waterways also control water erosion.

Flooding is the main limitation for most urban and recreational uses. Low soil strength is a limitation for roads and streets.

On rangeland the potential plant community is primarily mid grasses and scattered tall grasses. Typically, vine-mesquite makes up about 20 percent of the total vegetation. Sideoats grama makes up about 15 percent of this plant community and Arizona cottontop, plains bristlegrass, cane and silver bluestem, alkali sacaton, Texas wintergrass, blue grama, meadow dropseed, and white tridens make up about 40 percent. The rest is grasses, such as tobosa, western wheatgrass, scattered tall grasses, cool-season grasses, and sedges; forbs, such as Engelmann-daisy, bushsunflower, Maximilian sunflower, heath aster, dotted gayfeather, bundleflower, gaura, verbena, sagewort, trailing ratany, greenthread, eveningprimrose, and western ragweed; and woody plants, such as hackberry, elm, bumelia, vine ephedra, fourwing saltbush, wolfberry, pricklyash, catclaw acacia, western soapberry, and bois d'arc.

As the range deteriorates, the mid grasses decrease and are replaced by buffalograss, Texas wintergrass, and meadow dropseeds. Further heavy grazing leads to an invasion of mesquite, pricklypear, and annual grasses.

This soil provides good wildlife habitat for deer, dove, and quail. Most of the plants produced here provide valuable cover or food for wildlife.

This Gageby soil is in capability subclass IIw and the Draw range site.

12—Gageby clay loam, frequently flooded. This is a deep, nearly level soil on bottom land. Slopes average about 0.2 percent, but range from 0 to 1 percent. Soil areas are long and narrow and range from 15 to several hundred acres. This soil is flooded for a period of 2 to 7 days annually.

Typically, the surface layer is clay loam. It is dark grayish brown to a depth of about 8 inches and dark brown to a depth of about 25 inches. The subsoil extends to a depth of 43 inches. It is brown clay loam. To a depth of 60 inches the underlying material is light brown clay loam that contains about 25 percent, by volume, limestone fragments. This soil is calcareous and moderately alkaline throughout.

This soil is well drained. Surface runoff is slow. Permeability is moderate, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazards of erosion and soil blowing are slight. Some scouring and deposition of sediments take place during flooding.

Included in mapping are small areas of Colorado and Nipsum soils. These included soils make up as much as 20 percent of a mapped area.

This Gageby soil is not suitable for cultivation because of flooding. This soil is mainly rangeland. Flooding is the main limitation for most urban and recreational uses.

On rangeland the potential plant community is primarily mid grasses and scattered tall grasses. Typically, about 40 percent of the climax plant community is made up of Arizona cottontop, plains bristlegrass, cane and silver bluestem, alkali sacaton, Texas wintergrass, meadow dropseed, and white tridens. Vine-mesquite makes up about 20 percent of the total vegetation and sideoats grama makes up about 15 percent. The rest is tobosa, western wheatgrass, scattered tall grasses, cool-season grasses, and sedges; forbs, such as Engelmann-daisy, bushsunflower, Maximilian sunflower, heath aster, dotted gayfeather, bundleflower, gaura, verbena, sagewort, trailing ratany, greenthread, eveningprimrose, and western ragweed; and woody plants, such as hackberry, elm, bumelia, vine ephedra, fourwing saltbush, wolfberry, pricklyash, catclaw acacia, western soapberry, and bois d'arc.

As the range deteriorates, the mid grasses decrease and are replaced by buffalograss, Texas wintergrass, and the meadow dropseeds. Further heavy grazing leads to an invasion of mesquite, pricklypear, and annual grasses.

This soil provides good wildlife habitat for deer, dove, and quail. Most of the plants produced here provide valuable cover or food for wildlife.

This Gageby soil is in capability subclass Vw and the Draw range site.

13—Kavett clay, 0 to 1 percent slopes. This is a shallow, nearly level soil on uplands. Slopes average about 0.5 percent. Soil areas are irregularly shaped and range from 50 to 250 acres.

Typically, this soil has a surface layer of dark grayish brown clay about 8 inches thick. The next layer is dark brown silty clay about 9 inches thick. The underlying

material is indurated caliche about 3 inches thick. It is underlain by indurated fractured limestone bedrock. This soil is moderately alkaline and calcareous throughout.

This soil is well drained. Surface runoff is slow. Permeability is moderately slow, and the available water capacity is very low. The rooting zone is shallow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

Included in mapping are small areas of Mereta, Valera, and Tarrant soils and some small areas of gently sloping Kavett soils. These included soils make up as much as 15 percent of a mapped area.

This Kavett soil is mainly rangeland. A few areas are used for crops; however, it is poorly suited to this use. Small grains and forage sorghum are the main crops.

Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Contour farming and grassed waterways also help control water erosion.

This soil is poorly suited to most urban and recreational uses. Depth to rock, clayey texture, and shrinking and swelling are the most restrictive features. Low soil strength is a limitation for roads and streets.

On rangeland the potential plant community consists of mid and short grasses and scattered woody plants and forbs. Typically, sideoats grama makes up about 25 percent of the plant community when the range is in good condition. Buffalograss and curlymesquite make up about 20 percent of the vegetation and little bluestem and silver bluestem make up about 10 percent. The rest is grasses, such as Arizona cottontop, plains bristlegrass, green sprangletop, Texas wintergrass, reverchon bristlegrass, tall hairy grama, slim and rough tridens, vine-mesquite, plains lovegrass, Canada wildrye, bottlebrush squirreltail, fall witchgrass, and perennial threeawns; forbs, such as bushsunflower, Engelmann-daisy, eveningprimrose, halfshrub sundrop, orange zexmenia, bundleflower, catclaw sensitivebrier, prairie-clover, gaura, greeneyes, and verbena; and woody plants, such as live oak, shin oak, skunkbush sumac, littleleaf sumac, vine ephedra, agarito, condalia, and sticky selloa.

As the range deteriorates as a result of heavy grazing, mid grasses are replaced by buffalograss and threeawn. Further deterioration leads to an invasion of annual lovegrasses, windmillgrass, red grama, hairy tridens, annual brome, mesquite, lotebush, tasajillo, pricklypear, agarito, juniper, and annual forbs.

Deer, turkey, quail, and dove inhabit this area. Deer and turkey are more prevalent where there is a woody canopy.

This Kavett soil is in capability subclass IIIs and the Shallow range site.

14—Kavett clay, 1 to 3 percent slopes. This is a shallow, gently sloping soil on uplands. Slopes average about 2 percent. Soil areas are irregularly shaped and range from 30 to 200 acres.

Typically, this soil has a surface layer of calcareous, moderately alkaline silty clay about 16 inches thick. It is dark grayish brown in the upper part and brown in the lower part. To a depth of about 19 inches, the underlying material is light gray, hard, platy caliche. It is underlain by fractured indurated limestone bedrock.

This soil is well drained. Surface runoff is medium. Permeability is moderately slow, and the available water capacity is very low. The rooting zone is shallow. The hazards of erosion and soil blowing are moderate.

Included in mapping are small areas of Mereta, Valera, and Tarrant soils. Also included are small areas of nearly level Kavett soil. These included soils make up as much as 15 percent of a mapped area.

This Kavett soil is mainly rangeland, but a few areas are cultivated. Small grains and forage sorghum are the main crops.

This soil is poorly suited to crops. If used for this purpose, crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Contour farming and grassed waterways also help control water erosion.

This soil is poorly suited to most urban and recreational uses. Depth to rock and shrinking and swelling are the most restrictive features. Low soil strength is a limitation for roads and streets. A clayey surface layer also is a restrictive feature for recreational areas.

On rangeland the potential plant community consists of mid and short grasses and scattered woody plants and forbs. Typically, sideoats grama makes up about 25 percent of the total vegetation when the range is in good condition. Buffalograss and curlymesquite make up about 20 percent, and little bluestem and silver bluestem make up about 10 percent. The rest is grasses, such as Arizona cottontop, plains bristlegrass, green sprangletop, Texas wintergrass, reverchon bristlegrass, tall hairy grama, slim and rough tridens, vine-mesquite, plains lovegrass, Canada wildrye, bottlebrush squirreltail, fall witchgrass, and perennial threeawns; forbs, such as bushsunflower, Engelmann-daisy, eveningprimrose, halfshrub sundrop, orange zexmenia, bundleflower, catclaw sensitivebrier, prairie-clover, gaura, greeneyes, and verbena; and woody plants, such as live oak, shin oak, skunkbush sumac, littleleaf sumac, vine ephedra, agarito, condalia, and sticky selloa.

As the range deteriorates as a result of heavy grazing, mid grasses are replaced by buffalograss and threeawn. Further deterioration leads to an invasion of annual lovegrass, windmillgrass, red grama, hairy tridens, annual brome, mesquite, lotebush, tasajillo, pricklypear, agarito, juniper, and annual forbs.

Deer, turkey, quail, and dove inhabit this area. Deer and turkey are more prevalent where there is a woody canopy.

This Kavett soil is in capability subclass IIIe and the Shallow range site.

15—Knoco clay, 1 to 8 percent slopes. This is a very shallow, gently sloping and sloping soil on uplands. Slopes average about 3.5 percent. Soil areas are irregularly shaped and range from 20 to 250 acres.

Typically, this soil has a surface layer of calcareous, moderately alkaline, red clay about 8 inches thick. The underlying material is red clayey shale to a depth of about 30 inches.

This soil is well drained. Surface runoff is rapid. Permeability is very slow, and the available water capacity is very low. The rooting zone is very shallow. The hazard of erosion is severe, and the hazard of soil blowing is moderate.

Included in mapping are small areas of Vernon soil. Also included are small areas of closely similar soils that are 10 to 20 inches or less than 3 inches thick over clayey shale. These included soils make up as much as 50 percent of a mapped area.

This Knoco soil is not suitable for cultivation because of very shallow rooting depth, the hazard of erosion, and the very low available water capacity. This soil is mainly rangeland, but a few areas are used for crops.

This soil is poorly suited to urban and recreational uses. Shrinking and swelling and corrosivity to uncoated steel are the most limiting features. Low soil strength is a limitation for roads and streets. A clayey texture and very slow permeability are restrictions to recreational uses.

On rangeland the potential plant community consists of short and mid prairie grasses. Typically, sideoats grama, alkali sacaton, and tobosa make up about 45 percent of the total, and buffalograss and curlymesquite make up about 15 percent. The rest is grasses, such as cane and silver bluestem, vine-mesquite, little bluestem, Texas wintergrass, slim and rough tridens, white tridens, hairy grama, and perennial threeawn; forbs, such as wild alfalfa, buckwheat, Indian rushpea, dalea, prairie-clover, dotted gayfeather, gaura, Engelmann-daisy, catclaw sensitivebrier, and scurfpea; and woody plants, such as vine ephedra, wolfberry, catclaw acacia, yucca, and fourwing saltbush.

As the range deteriorates as a result of heavy grazing, sideoats grama is replaced by buffalograss and tobosa. Further deterioration leads to an invasion of hairy tridens, Texas grama, sand muhly, mesquite, pricklypear, juniper, and condalia. In its poorest condition, this soil produces annual grasses and forbs or the ground is bare.

This soil has fair potential for wildlife habitat. A few dove and quail inhabit the area. Deer and other wildlife are not attracted to the site because of sparse protective cover and food.

This Knoco soil is in capability subclass VIIs and the Shallow Clay range site.

16—Latom-Rock outcrop association, rolling. This association is on uplands. It consists of a very shallow to shallow, sloping to moderately steep soil intermingled with Rock outcrop. It is about 50 percent Latom soil, 30 percent Rock outcrop, and 20 percent other soils. Slopes range from 5 to 16 percent but average about 15 percent. Areas of the association are irregular in shape and range from 25 to 425 acres.

This association is more variable in composition than other map units in the county. Mapping has been controlled well enough, however, for the anticipated use of the areas involved.

The Latom soil typically has a surface layer of calcareous, moderately alkaline, reddish brown fine sandy loam about 5 inches thick. This is underlain by reddish gray, strongly cemented sandstone bedrock. Rock outcrop consists of exposed sandstone ledges and boulders.

The Latom soil is well drained. Surface runoff is rapid. Permeability is moderate, and the available water capacity is very low. The hazards of water erosion and soil blowing are moderate.

Included in mapping are small areas of Quinlan soils and areas of sandstone bedrock that are covered with 4 inches or less of loamy material. Also included are a few nearly barren exposures of red-bed clays. These included soils make up about 20 percent of a mapped area.

The Latom soil is not suitable for cultivation because it has rolling slopes and a very shallow rooting depth. This soil is mainly rangeland; however, the forage yields of native range plants are low.

This association is poorly suited to most urban and recreational uses. Slope and depth to rock are the most limiting features.

On rangeland the potential plant community is a mixture of tall, mid, and short grasses and a good variety of forbs and woody plants. Sideoats grama makes up about 25 percent of the total plant community, and indiangrass, big bluestem, and little bluestem make up about 20 percent. The rest is grasses, such as black grama, cane and silver bluestem, hairy grama, buffalograss, curlymesquite, blue grama, slim and rough tridens, threeawn, fall witchgrass, Texas wintergrass, and New Mexico feathergrass; forbs, such as dotted gayfeather, rockdaisy, prairie-clover, gaura, bushsunflower, trailing ratany, eveningprimrose, Indian mallow, penstemon, dalea, white sage, and catclaw sensitivebrier; and woody plants, such as littleleaf sumac, skunkbush sumac, vine ephedra, catclaw acacia, wolfberry, agarito, javalinabush, redberry juniper, yucca, and greenbrier.

As the range deteriorates, tall and mid grasses and palatable forbs are replaced by buffalograss, threeawn, slim and rough tridens, and feathery bluestem. Further deterioration leads to an invasion of threeawn, hairy tridens, broom snakeweed, and annual forbs.

The soil provides limited food and cover for wildlife. Quail, doves, and other ground-nesting birds frequent the site.

The Latom soils are in capability subclass VIIs and the Very Shallow range site. Rock outcrop is not assigned a capability subclass or range site.

17—Lozier-Rock outcrop association, steep. The association is on the escarpment that divides the Edwards Plateau Land Resource Area from the Rolling Plains Land Resource Area. It consists of a very shallow soil intermingled with outcrops of limestone. It is 31 percent Rock outcrop, 44 percent Lozier soil, 19 percent closely similar Ector soil, and 6 percent other soils. Slopes range from 20 to 40 percent and average about 25 percent. Areas of the association are long and narrow. They are several miles long.

This association is more variable in composition than other map units in the county. Mapping has been controlled well enough, however, for the anticipated use of the areas involved.

Typically, the Lozier soil has a surface layer of calcareous, moderately alkaline, light brownish gray very gravelly loam about 5 inches thick. It rests abruptly on a layer of limestone fragments that are coated with caliche, or secondary calcium carbonate. Below this at a depth of about 12 inches is limestone bedrock. The Rock outcrop consists of ledges and other barren exposures of limestone.

The Lozier soil is well drained. Surface runoff is rapid. Permeability is moderate, and the available water capacity is very low. The hazard of water erosion is severe, and the hazard of soil blowing is slight.

This association is mainly rangeland. It is not suitable for cultivation because of rock outcrop, slope, the very shallow rooting depth, and its susceptibility to water erosion.

This association is poorly suited to most urban and recreational uses. Slope and depth to rock are the most limiting features.

On rangeland the potential plant community consists of mid grasses and scattered tall grasses and a variety of forbs and woody plants. Typically, sideoats grama and little bluestem each makes up about 20 percent of the total vegetation. The rest is grasses, such as feathery bluestem, green sprangletop, indiangrass, plains lovegrass, Texas cupgrass, tall and hairy dropseed, Canada wildrye, Texas wintergrass, fall witchgrass, slim and rough tridens, tall and hairy grama, perennial threeawn, and sedges; forbs, such as Engelmann-daisy, bushsunflower, orange zexmenia, bundleflower, gaura, dozedaisy, eveningprimrose, halfshrub sundrop, and catclaw sensitivebrier; and woody plants, such as live oak, shin oak, ashe juniper, kidneywood, hackberry, redbud, grape, cacti, yucca, Lindheimer silktassel, and sumac.

As the range deteriorates as a result of heavy grazing, woody plants increase, and the better grasses are replaced by hairy tridens, red grama, Texas grama, and annual forbs. In some places, juniper dominates the site.

This association provides mixed woody vegetation which is used as food and cover by deer and turkey. The steep, rocky slopes furnish shelter for many furbearing animals.

The Lozier soil is in capability subclass VIIs and the Steep Rocky range site. Rock outcrop is not assigned a capability subclass or range site.

18—Mereta clay loam, 0 to 1 percent slopes. This is a shallow, nearly level soil on upland plains. Slopes average about 0.5 percent. Soil areas are irregularly shaped and range from 15 to 120 acres.

Typically, this soil has a surface layer of calcareous, moderately alkaline, brown clay loam about 18 inches thick. To a depth of about 22 inches, the next layer is strongly cemented caliche. This is underlain by loam that is about 80 percent, by volume, soft masses of calcium carbonate.

This soil is well drained. Surface runoff is slow. Permeability is moderately slow, and the available water capacity is low. The rooting zone is shallow. The hazards of water erosion and soil blowing are slight.

Included in mapping are small areas of Veal and Rowena soils. Also included are areas of gently sloping Mereta soils and some soils similar to the Mereta soils that are more than 20 inches to the cemented caliche layer. These included soils make up 10 percent or less of a mapped area.

This Mereta soil is mainly rangeland, but a few areas are cultivated. Cotton and small grains are the main crops.

This soil is moderately well suited to cotton and small grains. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Contour farming, terraces, and grassed waterways also help control water erosion. When cuts or excavations exceed a depth of 10 inches, there is a hazard of cutting into indurated caliche.

This soil is moderately well suited to most urban uses. A cemented pan, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features. This soil is poorly suited to recreational uses because it has a cemented pan.

On rangeland the potential plant community consists of mid and short grasses and scattered woody plants and forbs. Typically, sideoats grama makes up about 25 percent of the total plant community. Buffalograss and curlymesquite make up about 20 percent, and little bluestem and silver bluestem make up about 10 percent. The rest is grasses, such as Arizona cottontop, plains bristlegrass, green sprangletop, Texas wintergrass, reverchon bristlegrass, tall hairy grama, slim and rough tridens, vine-mesquite, plains lovegrass, Canada wildrye, bottlebrush squirreltail, fall witchgrass, and perennial threeawn; forbs, such as bushsunflower, Engelmann-daisy, eveningprimrose, halfshrub sundrop, orange zexmenia, bundleflower, catclaw sensitivebrier, prairie-clover, gaura, greeneyes, and verbena; and woody plants, such as live oak, shin oak, skunkbush sumac, littleleaf sumac, vine ephedra, agarito, condalia, and sticky selloa.

As the range deteriorates as a result of heavy grazing, mid grasses are replaced by buffalograss and threeawn. Further deterioration leads to an invasion of annual lovegrass, windmillgrass, red grama, hairy tridens, annual brome, mesquite, lotebush, tasajillo, pricklypear, agarito, juniper, and annual forbs.

Deer, turkey, quail, and dove inhabit these areas. Deer

and turkey are more prevalent where there is a woody canopy.

This Mereta soil is in capability subclass IIIs and the Shallow range site.

19—Mereta clay loam, 1 to 3 percent slopes. This is a shallow, gently sloping soil on upland plains. Slopes average about 2 percent. Soil areas are oval and range from 20 to 300 acres.

Typically, this soil has a surface layer of brown, calcareous, moderately alkaline clay loam about 18 inches thick. The next layer is strongly cemented caliche about 4 inches thick. The underlying material to a depth of about 40 inches is loam that is about 80 percent, by volume, soft masses of calcium carbonate.

This soil is well drained. Surface runoff is slow. Permeability is moderately slow, and the available water capacity is low. The rooting zone is shallow. The hazards of water and wind erosion are moderate.

Included in mapping are small areas of Veal and Rowena soils. Also included are small areas of soils similar to Mereta soils that are more than 20 inches to the cemented caliche layer. These included soils make up about 15 percent of a mapped area.

This Mereta soil is used as rangeland and cropland. Cotton and small grains are the main crops.

This soil is moderately well suited to cotton and small grains. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Contour farming and grassed waterways also help control water erosion.

This soil is moderately suited to most urban uses. A cemented pan, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features. It is poorly suited to recreational uses. A clayey surface layer and a cemented pan are limitations for this use.

On rangeland the potential plant community consists of mid and short grasses and scattered woody plants and forbs. Typically, sideoats grama makes up about 25 percent of the total vegetation when the range is in good condition. Buffalograss and curlymesquite make up about 20 percent, and little bluestem and silver bluestem make up about 10 percent. The rest is grasses, such as Arizona cottontop, plains bristlegrass, green sprangletop, Texas wintergrass, reverchon bristlegrass, tall hairy grama, slim and rough tridens, vine-mesquite, plains lovegrass, Canada wildrye, bottlebrush squirreltail, fall witchgrass, and perennial threeawn; forbs, such as bushsunflower, Engelmann-daisy, eveningprimrose, halfshrub sundrop, orange zexmenia, bundleflower, catclaw sensitivebrier, prairie-clover, gaura, greeneyes, and verbena; and woody plants, such as live oak, shin oak, skunkbush sumac, littleleaf sumac, vine ephedra, agarito, condalia, and sticky selloa.

As the range deteriorates as a result of heavy grazing, mid grasses are replaced by buffalograss and threeawn. Further deterioration leads to an invasion of annual lovegrasses, windmillgrass, red grama, hairy tridens, annual brome, mesquite, lotebush, tasajillo, pricklypear, agarito, juniper, and annual forbs.

Deer, turkey, quail, and dove inhabit these areas. Deer and turkey are more prevalent where there is a woody canopy.

This Mereta soil is in capability subclass IIIe and the Shallow range site.

20—Miles loamy fine sand, 0 to 3 percent slopes. This is a deep, nearly level to gently sloping soil on upland plains. Slopes average about 2 percent. Soil areas are irregularly shaped and range from 15 to 50 acres.

Typically, this soil has a surface layer of brown loamy fine sand about 8 inches thick. The subsoil extends to a depth of 80 inches or more. It is sandy clay loam that is reddish brown in the upper part and yellowish red in the lower part. This soil is typically neutral in the upper part and moderately alkaline in the lower part.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water capacity is medium. The rooting zone is deep and easily penetrated by plant roots. The hazard of water erosion is slight, and the hazard of soil blowing is severe.

Included in mapping are small areas of Cobb soils. Also included is a soil similar to Miles soil that has a clayey subsoil and a few areas of soils closely similar to Miles soils that have a mottled subsoil and grayish layers below a depth of 40 inches. These included soils make up as much as 20 percent of a mapped area.

This Miles soil is mainly rangeland, but a few areas are used for crops. Small grains and forage sorghum are the main crops.

This soil is moderately well suited to small grains or forage sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing. They also conserve moisture by lowering evaporation from the soil. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming and grassed waterways also help control water erosion.

This soil is well suited to most urban and recreational uses. Seepage and corrosivity to uncoated steel are the most restrictive features, but these are easily overcome by good design and careful installation procedures. A sandy surface layer is a limitation for some recreational uses.

On rangeland the potential plant community consists of tall and mid grasses and scattered mottes of oak and sumac. Sand bluestem and indiangrass make up about 20 percent of the plant community, and little bluestem makes up about 15 percent. Sideoats grama, plains bristlegrass, Arizon cottontop, hairy grama, sand dropseed, hooded windmillgrass, fall witchgrass, and Wright threeawn make up about 40 percent of the vegetation. The rest is woody plants, such as hackberry, sand sagebrush, skunkbush sumac, littleleaf sumac, bumelia, pricklyash, shin oak, and yucca, and forbs, such as Engelmann-daisy, bundleflower, primrose, prairie-clover, gaura, dotted gayfeather, sagewort, milkvetch, western ragweed, and heath aster.

As the range deteriorates, tall grasses and palatable

forbs are grazed out and replaced by sideoats grama and little bluestem. With continued heavy grazing, these plants are replaced by hooded windmillgrass, fall witchgrass, and sand dropseed. Eventually tumble windmillgrass, gummy lovegrass, and fringed signalgrass invade the area, and sand sagebrush, mesquite, and yucca form a dense stand of woody plants.

Quail and doves inhabit the area because there is good protective vegetation. This soil produces an abundance of annual and perennial seed plants.

This Miles soil is in capability subclass IIIe and the Loamy Sand range site.

21—Miles loamy fine sand, 3 to 5 percent slopes. This is a deep, gently sloping soil on uplands. Slopes average about 4 percent. Soil areas are long and narrow and range from 25 to 50 acres.

Typically, this soil has a surface layer of pale brown loamy fine sand about 14 inches thick. The subsoil, which extends to a depth of about 64 inches, is sandy clay loam that is yellowish red in the upper part and red in the lower part. This soil is typically neutral in the upper part and moderately alkaline in the lower part.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water capacity is medium. The rooting zone is deep and easily penetrated by plant roots. The hazard of water erosion is moderate, and the hazard of wind erosion is severe.

Included in mapping are small areas of Cobb soils. Also included are small areas of soils closely similar to Miles soils. One has a clayey subsoil, and the other has a sandy loam underlying layer. These included soils make up less than 20 percent of a mapped area.

This Miles soil is mainly rangeland. A few areas are used for crops. Small grains and forage sorghum are the main crops.

Yields of small grains and forage sorghum are generally low on this soil. Crop residues should be kept on the soil surface to control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming and grassed waterways also help control water erosion.

This soil is well suited to most urban and recreational uses. Seepage and corrosivity to uncoated steel are the most restrictive features, but these are easily overcome by good design and careful installation procedures. Slope and a sandy surface restrict some recreational uses.

On rangeland the potential plant community consists of tall and mid grasses and scattered mottes of oak and sumac. Sand bluestem and indiangrass make up about 20 percent of the plant community, and little bluestem makes up about 15 percent. Sideoats grama, plains bristlegrass, Arizona cottontop, hairy grama, sand dropseed, hooded windmillgrass, fall witchgrass, and Wright threeawn make up about 40 percent. The rest is woody plants, such as hackberry, sand sagebrush, skunkbush sumac, littleleaf sumac, bumelia, pricklyash, shin oak, and yucca, and forbs, such as Engelmann-daisy, bundleflower, primrose, prairie-clover, gaura, dotted gayfeather, sagewort, milkvetch, western ragweed, and heath aster.

As the range deteriorates, tall grasses and palatable forbs are grazed out and replaced by sideoats grama and little bluestem. With continued heavy grazing, these plants are replaced by hooded windmillgrass, fall witchgrass, and sand dropseed. Eventually tumble windmillgrass, gummy lovegrass, and fringed signalgrass invade the area, and sand sagebrush, mesquite, and yucca form a dense stand of woody plants.

Quail and doves inhabit the area because there is good protective vegetation. This soil produces an abundance of annual and perennial seed plants.

This Miles soil is in capability unit IVe and the Loamy Sand range site.

22—Miles fine sandy loam, 1 to 3 percent slopes. This is a deep, gently sloping soil on uplands. Slopes average about 2 percent. Soil areas are oval to irregular in shape and range from 60 to 150 acres.

Typically, this soil has a surface layer of reddish brown fine sandy loam about 10 inches thick. The subsoil is sandy clay loam that is reddish brown to a depth of about 18 inches, yellowish red to a depth of 52 inches, and reddish yellow with common concretions of calcium carbonate to a depth of 63 inches. The underlying material to a depth of about 80 inches is red fine sandy loam. This soil is typically neutral in the upper part and grades to moderately alkaline in the lower part.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water capacity is medium. The rooting zone is deep and easily penetrated by plant roots. The hazards of water erosion and soil blowing are moderate.

Included in mapping are small areas of Cobb and Rotan soils. Also included are small areas of soils that are similar to the Miles soil, but one has a clayey subsoil and the other has yellowish brown mottles in the subsoil. These included soils make up as much as 20 percent of a mapped area.

This Miles soil is mainly cropland. A few areas are rangeland. Cotton, small grains, and grain sorghum are the main crops.

This soil is well suited to crops. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways help control water erosion.

This soil is well suited to rangeland. Low rainfall is the most limiting factor, but yields of short and mid grasses are good during favorable years.

This soil is well suited to urban and recreation uses. Slope, seepage, and corrosivity to uncoated steel are the most restrictive features, but these are easily overcome by good design and careful installation procedures. Slope restricts the use of some areas for playgrounds.

On rangeland the potential plant community is primarily mid grasses. Typically, sideoats grama and buffalograss make up about 40 percent of the plant community. Little bluestem, plains bristlegrass, Arizona cottontop, and vine-mesquite make up another 40 percent. The rest is grasses, such as sand dropseed, hooded windmillgrass, hairy grama, silver bluestem, fall witchgrass, plains lovegrass, and Wright threeawn; forbs, such as catclaw sensitivebrier, halfshrub eveningprimrose, trailing ratany, Engelmann-daisy, gaura, sagewort, dotted gayfeather, western ragweed, and heath aster; and woody plants, such as yucca, catclaw, agarito, hackberry, skunkbush sumac, bumelia, littleleaf sumac, and sand sagebrush.

As the range deteriorates as a result of heavy grazing, sideoats grama and little bluestem are grazed out and replaced by threeawn, sand dropseed, and buffalograss. Eventually plants such as mesquite trees, pricklypear, condalia, and numerous annuals invade the site.

Where this soil is used for wildlife habitat, birds such as quail and dove frequent the area because of the abundance of seed plants.

This Miles soil is in capability subclass IIIe and the Sandy Loam range site.

23—Miles fine sandy loam, 3 to 5 percent slopes. This is a deep, gently sloping soil on uplands. Slopes average about 4 percent. Soil areas are long and narrow and range from 25 to 50 acres.

Typically, this soil has a surface layer of reddish brown fine sandy loam about 4 inches thick. The subsoil extends to a depth of 62 inches. It is sandy clay loam that is reddish brown in the upper part, red in the middle, and reddish brown with common masses of calcium carbonate in the lower part. The underlying material is massive, red shaly clay. This soil is typically moderately alkaline throughout.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water capacity is medium. The rooting zone is deep and easily penetrated by plant roots. The hazards of water erosion and wind erosion are moderate.

Included in mapping are small areas of Cobb soil and a few eroded areas of Miles soil. Also included are small areas of soils similar to Miles soil. One has a clayey subsoil and the other has caliche above 60 inches. These included soils make up as much as 20 percent of a mapped area.

This Miles soil is mainly rangeland. A few areas are used for crops. Small grains and forage sorghum are the main crops.

This soil is moderately well suited to cropland. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, diversion terraces, and grassed waterways also control water erosion.

This soil is well suited to most urban and recreational uses. Seepage and corrosivity to uncoated steel are the most restrictive features, but these are easily overcome by good design and careful installation procedures. Slope restricts some recreational uses.

On rangeland the potential plant community is primarily mid grasses. Typically, sideoats grama and buffalograss make up about 40 percent of the plant community. Little bluestem, plains bristlegrass, Arizona cottontop, and vine-mesquite make up another 40 percent of the vegetation. The rest is grasses, such as sand dropseed, hooded windmillgrass, hairy grama, silver bluestem, fall witchgrass, plains lovegrass, and Wright threeawn; forbs, such as catclaw sensitivebrier, halfshrub eveningprimrose, trailing ratany, Engelmann-daisy, gaura, sagewort, dotted gayfeather, western ragweed, and heath aster; and woody plants, such as yucca, catclaw, agarito, hackberry, skunkbush sumac, bumelia, littleleaf sumac, and sand sagebrush.

As the range deteriorates as a result of heavy grazing, sideoats grama and little bluestem are grazed out and replaced by threeawn, sand dropseed, and buffalograss. Eventually plants such as mesquite trees, pricklypear, condalia, and numerous annuals invade the site.

Where this soil is used for wildlife habitat, birds such as quail and dove frequent the area because of the abundance of seed plants.

This Miles soil is in capability unit IIIe and the Sandy Loam range site.

24—Nipsum clay loam, 0 to 1 percent slopes. This is a deep, nearly level soil on uplands. Slopes average about 0.5 percent. Soil areas are long and narrow and range from 50 to 150 acres (fig. 5).

Typically, this soil has a dark grayish brown surface layer about 22 inches thick. It is clay loam in the upper part and clay in the lower part. The subsoil, which extends to a depth of about 49 inches, is brown clay. The underlying material is reddish brown silty clay loam to a depth of about 60 inches. This soil is calcareous and moderately alkaline throughout.

This soil is well drained. Surface runoff is slow. Permeability is slow, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. A few areas are subject to rare flooding.

Included in mapping are small areas of Gageby, Rotan, and Rowena soils and some small areas of gently sloping Nipsum soils. These included soils make up as much as 20 percent of a mapped area.

This Nipsum soil is mainly rangeland, but a few areas are for crops. Cotton and grain sorghum are the main crops.

This soil is moderately well suited to cotton and grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues

Figure 5.—Landscape of Nipsum clay loam, 0 to 1 percent slopes, with Lozier-Rock outcrop association, steep, on the escarpment in the background.

do not furnish adequate protection. Contour farming, diversion terraces, and grassed waterways also help control water erosion.

This soil is moderately well suited to urban uses. Clayey texture, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features. Low soil strength is a limitation for roads and streets. These limitations can be overcome by good design and careful installation procedures. In some places local flooding may be a restriction. This soil is well suited to recreation uses.

On rangeland the potential plant community consists of short and mid prairie grasses and scattered browse. Typically, sideoats grama, buffalograss, tobosa, and vine-mesquite make up 75 percent of the plant community. Arizona cottontop, silver bluestem, white tridens, Texas wintergrass, and sand dropseed make up about 15 percent. The rest is forbs, such as dotted gayfeather, milkvetch, and gaura, and woody plants, such as lotebush, agarito, ephedra, and wolfberry.

As the range deteriorates as a result of heavy grazing, blue grama, sideoats grama, and vine-mesquite decrease and are replaced by tobosa and buffalograss. With further deterioration, buffalograss decreases and mesquite and pricklypear invade the area. Annual forbs, red grama, purple threeawn, and hairy tridens eventually make up most of the vegetation.

This soil produces good habitat for quail and dove in the form of annual seed plants.

This Nipsum soil is in capability subclass IIc and the Clay Loam range site.

25—Nipsum clay loam, 1 to 3 percent slopes. This is a deep, gently sloping soil on uplands. Slopes average about 2 percent. Soil areas are long and narrow and range from 30 to several hundred acres.

Typically, this soil has a dark grayish brown surface layer about 28 inches thick. It is clay loam in the upper part and clay in the lower part. The subsoil, which extends to a depth of 48 inches, is brown clay. The underlying layer is reddish brown clay loam to a depth of about 60 inches. This soil is moderately alkaline throughout.

This soil is well drained. Surface runoff is medium. Permeability is slow, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazards of water erosion and soil blowing are moderate. Parts of this map unit are subject to rare flooding.

Included in mapping are small areas of Gageby, Rotan, Rowena, and Shep soils and also a few areas of nearly level Nipsum soils. These included soils make up as much as 20 percent of a mapped area.

This Nipsum soil is mainly rangeland, but a few areas are used for crops. Cotton and grain sorghum are the main crops.

This soil is moderately well suited to crops. Crop residues should be kept on the soil surface to help

control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, diversion terraces, and grassed waterways control water erosion.

This soil is moderately well suited to most urban uses. Clayey texture, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features. Low soil strength is a limitation for roads and streets. These limitations are overcome by good design and careful installation procedures. In some places rare local flooding may be a limitation. This soil is well suited to recreational uses.

On rangeland the potential plant community consists of short and mid prairie grasses and scattered browse. Typically, sideoats grama, buffalograss, tobosa, and vine-mesquite make up 75 percent of the plant community. Arizona cottontop, silver bluestem, white tridens, Texas wintergrass, and sand dropseed make up about 15 percent. The rest is forbs, such as dotted gayfeather, milkvetch, and gaura, and woody plants, such as lotebush, agarito, ephedra, and wolfberry.

As the range deteriorates as a result of heavy grazing, sideoats grama and vine-mesquite decrease and are replaced by tobosa and buffalograss. With further deterioration, buffalograss decreases and mesquite and pricklypear invade the area. Annual forbs, red grama, purple threeawn, and hairy tridens eventually make up most of the vegetation.

This soil produces good habitat for quail and dove in the form of annual seed plants.

This Nipsum soil is in capability subclass IIe and the Clay Loam range site.

26—Paducah loam, 1 to 3 percent slopes. This is a deep, gently sloping soil on uplands. Slopes average about 2 percent. Soil areas are irregularly shaped and range from 60 to 200 acres.

Typically, this soil has a surface layer of reddish brown loam about 7 inches thick. The subsoil extends to a depth of 48 inches. It is reddish brown silty clay loam to a depth of 42 inches and is yellowish red loam in the lower part. The underlying material, to a depth of 54 inches, is reddish yellow loam. This is underlain to a depth of 68 inches or more by light reddish brown, weakly cemented sandstone.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazards of erosion and soil blowing are slight.

Included in mapping are small areas of Woodward and Quinlan soils. Also included are small areas of soils similar to Paducah soils that have a dark colored surface layer. These included soils make up as much as 20 percent of a mapped area.

This Paducah soil is mainly cropland. Cotton and small grains are the main crops. A few areas are rangeland.

This soil is moderately well suited to crops. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also control water erosion.

This soil is well suited to most urban and recreational uses. Slope, seepage, and corrosivity to uncoated steel are the most restrictive features, but these are easily overcome by good design and careful installation procedures. Low soil strength is a limitation for local roads and streets. Slope restricts the use of some areas for playgrounds.

On rangeland the potential plant community consists of mid and short grasses and a variety of forbs and woody plants. Buffalograss and curlymesquite make up about 20 percent of the plant community when the range is in good condition. Sideoats grama makes up about 15 percent; plains bristlegrass, vine-mesquite, Arizona cottontop, and little bluestem make up 25 percent; and hairy grama, cane and silver bluestem, sand dropseed, hooded windmillgrass, black grama, and purple and Wright threeawns make up about 25 percent. The rest is cool-season grasses, such as Texas wintergrass, Canada wildrye, Hall panicum, and fall witchgrass; forbs, such as Engelmann-daisy, Maximilian sunflower, heath aster, trailing ratany, bundleflower, catclaw sensitivebrier, gaura, prairie-clover, wild alfalfa, sagewort, dotted gayfeather, skeletonplant, buckwheat, and groundcherry; and woody plants, such as littleleaf sumac, skunkbush sumac, bumelia, elbowbush, hackberry, dalea, fourwing saltbush, vine ephedra, agarito, wolfberry, catclaw acacia, yucca, and juniper.

As the range deteriorates, sideoats grama is replaced by buffalograss, sand dropseed, and threeawns. Further heavy grazing leads to an invasion of hairy tridens, red grama, sand muhly, mesquite, juniper, pricklypear, yucca, and tasajillo.

Areas of this soil are used heavily by deer, dove, and quail. The plant varieties provide good food and cover for wildlife.

This Paducah soil is in capability subclass IIe and the Loamy Prairie range site.

27—Paducah loam, 3 to 5 percent slopes. This is a deep, gently sloping soil on uplands. Slopes average about 4 percent. Soil areas are long and narrow and range from 30 to 150 acres.

Typically, this soil has a surface layer of reddish brown loam about 6 inches thick. The subsoil extends to a depth of 38 inches. It is red silty clay loam to a depth of about 16 inches, and yellowish red silt loam to a depth of about 38 inches. The underlying material is massive, yellowish red very fine sandy loam. This soil is typically mildly alkaline throughout.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water

capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included in mapping are small areas of Woodward and Quinlan soils. Also included are small areas of sloping Paducah soils. These included soils make up less than 15 percent of a mapped area.

This Paducah soil is mainly cropland. Cotton and small grains are the main crops. A few areas are rangeland.

This soil is moderately well suited to crops. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to help control soil blowing if crop residues do not furnish adequate protection. Contour farming, diversions, terraces, and grassed waterways also control water erosion.

This soil is well suited to most urban and recreational uses. Slope, seepage, and corrosivity to uncoated steel are the most restrictive features, but these are easily overcome by good design and careful installation procedures. Low soil strength is a limitation for local roads and streets.

On rangeland the potential plant community consists of mid and short grasses and a variety of forbs and woody plants. Buffalograss and curlymesquite make up about 20 percent of the plant community when the range is in good condition. Sideoats grama makes up 15 percent; plains bristlegrass, vine-mesquite, Arizona cottontop, and little bluestem make up about 25 percent; and hairy grama, cane and silver bluestem, sand dropseed, hooded windmillgrass, black grama, and purple and Wright threeawns make up about 25 percent. The rest is cool-season grasses, such as Texas wintergrass, Canada wildrye, Hall panicum, and fall witchgrass; forbs, such as Engelmann-daisy, Maximilian sunflower, heath aster, trailing ratany, bundleflower, catclaw sensitivebrier, gaura, prairie-clover, wild alfalfa, sagewort, dotted gayfeather, skeletonplant, buckwheat, and groundcherry; and woody plants, such as littleleaf sumac, skunkbush sumac, bumelia, elbowbush, hackberry, dalea, fourwing saltbush, vine ephedra, agarito, wolfberry, catclaw acacia, yucca, and juniper.

As the range deteriorates, sideoats grama is replaced by buffalograss, sand dropseed, and threeawn. Further heavy grazing leads to an invasion of hairy tridens, red grama, sand muhly, mesquite, juniper, pricklypear, yucca, and tasajillo.

This soil is used heavily by deer, dove, and quail. The plant varieties provide good food and cover for wildlife.

This Paducah soil is in capability subclass IIIe and the Loamy Prairie range site.

28—Pits. Pits are areas from which limestone, gypsum, and gravel have been mined. Limestone pits are mainly in Ector soils, gypsum pits are mainly in Acme and Cottonwood soils, and gravel pits are mainly in Pitzer soils. The Pit areas range from 4 to 600 acres.

Pits are not suitable for farming. The areas in which gypsum has been mined are mostly piles of spoil material. Some of the abandoned areas can be reclaimed and used for limited grazing or wildlife habitat if they are shaped and if suitable grasses, forbs, and trees are established on them.

Pits were not assigned a capability subclass or range site.

29—Pitzer gravelly loam, 1 to 8 percent slopes. This is a shallow to very shallow, undulating soil on uplands. Slopes average about 4 percent. Soil areas are oval and range from 30 to 150 acres.

Typically, this soil has a surface layer of moderately alkaline, dark brown gravelly loam about 6 inches thick. The underlying material is white indurated caliche plates in about the upper 6 inches (fig. 6), and it is reddish yellow extremely gravelly sandy loam to a depth of about 54 inches.

This soil is well drained. Surface runoff is medium. Permeability is moderate in the soil and slow to very slow in the caliche. The available water capacity is very low. The rooting zone is very shallow. The hazard of water erosion is severe, and the hazard of soil blowing is slight.

Included in mapping are small areas of Mereta soils. Also included is soil similar to Pitzer soil that has a light colored surface layer. These included soils make up as much as 30 percent of a mapped area.

The Pitzer soil is mainly rangeland. It is too shallow and gravelly to be cultivated.

This Pitzer soil has low potential for most urban uses. Depth to a cemented pan and slope are the most restrictive features. It also has low potential for recreational uses. Small stones and slope are restrictive features.

On rangeland the potential plant community is a mixture of mid and short grasses and a good variety of forbs and woody plants. Sideoats grama makes up about 25 percent of the plant community, and little bluestem make up about 20 percent. The rest is grasses, such as black grama, cane and silver bluestem, hairy grama, buffalograss, curlymesquite, blue grama, slim and rough tridens, threeawn, fall witchgrass, Texas wintergrass, and New Mexico feathergrass; forbs, such as dotted gayfeather, rockdaisy, prairie-clover, gaura, bushsunflower, trailing ratany, eveningprimrose, Indian mallow, penstemon, dalea, white sage, and catclaw sensitivebrier; and woody plants, such as littleleaf sumac, skunkbush sumac, vine ephedra, catclaw acacia, wolfberry, agarito, javalinabush, redberry juniper, yucca, and greenbrier.

As the range deteriorates, mid grasses and palatable forbs are replaced by buffalograss, threeawn, slim and rough tridens, and feathery bluestem. Further deterioration leads to an invasion of threeawn, hairy tridens, broom snakeweed, and annual forbs.

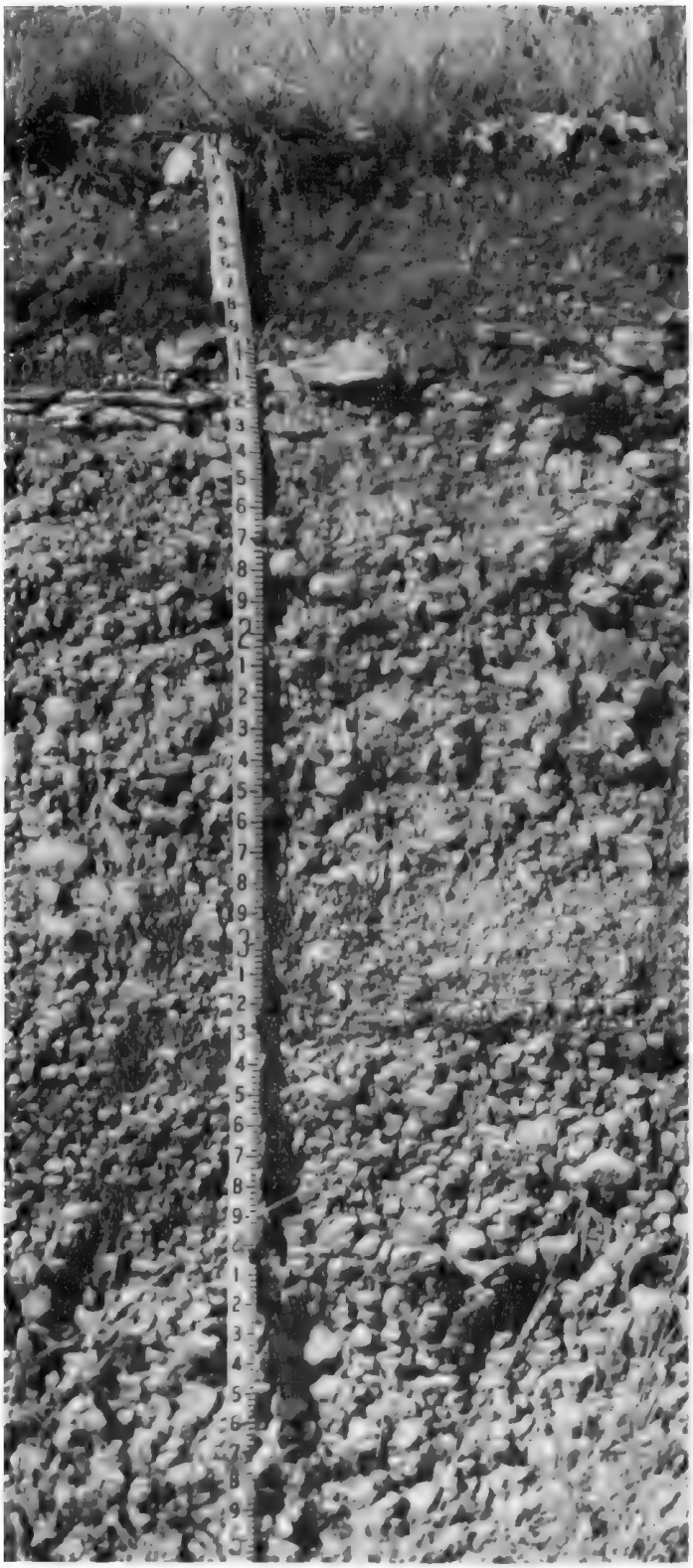


Figure 6.—Soil profile of Pitzer gravelly loam, 1 to 8 percent slopes, showing a petrocalcic horizon at about 12 inches.

This soil provides limited food and cover for wildlife. Quail, doves, and other ground-nesting birds frequent the site.

This Pitzer soil is in capability subclass VIs and the Very Shallow range site.

30—Potter gravelly loam, 1 to 20 percent slopes. This is a very shallow, gently undulating to hilly soil on uplands. Slopes range from 1 to 20 percent but average about 3 percent on ridges and 12 percent on the side slopes. Soil areas are oblong to irregularly shaped and range from 100 to several hundred acres.

Typically, this soil has a surface layer of calcareous, moderately alkaline, grayish brown gravelly loam about 5 inches thick. It rests abruptly on a layer of white platy caliche about 7 inches thick. Below this the underlying material is massive, white, limy earth several feet thick.

This soil is well drained. Surface runoff is rapid. Permeability is moderate, and the available water capacity is very low. The hazard of water erosion is severe, and the hazard of soil blowing is slight.

Included in mapping are small areas of Ector, Shep, and Veal soils. Included also are areas of caliche covered with 3 inches or less of soil, some limestone outcrops, and some conglomerate boulders. Also included is a soil closely similar to Potter soil that is more than 12 inches deep to caliche. These included soils and Rock outcrop make up as much as 30 percent of a mapped area.

This Potter soil is mainly rangeland. It is not suitable for cultivation because of slope, the very shallow rooting depth, and susceptibility to water erosion.

This soil is poorly suited for most urban uses. Slope, very shallow rooting depth, seepage, corrosivity to uncoated steel, and large stones are the most limiting features. This soil is moderately well suited to recreational uses. Slope is the most restrictive feature for this use.

On rangeland the potential plant community consists of a mixture of tall, mid, and short grasses and a good variety of forbs and woody plants. Sideoats grama makes up about 25 percent of the plant community. Indiangrass and big bluestem make up about 10 percent, and little bluestem make up about 20 percent. The rest is grasses, such as black grama, cane and silver bluestem, hairy grama, buffalograss, curlymesquite, blue grama, slim and rough tridens, threeawn, fall witchgrass, Texas wintergrass, and New Mexico feathergrass; forbs, such as dotted gayfeather, rockdaisy, prairie-clover, gaura, bushsunflower, trailing ratany, eveningprimrose, Indian-mallow, penstemon, dalea, white sage, and catclaw sensitivebrier; and woody plants, such as littleleaf sumac, skunkbush sumac, vine ephedra, catclaw acacia, wolfberry, agarito, javalinabush, redberry juniper, yucca, and greenbrier.

As the range deteriorates, tall grasses and palatable forbs are replaced by buffalograss, threeawn, slim and rough tridens, and feathery bluestem. Further

deterioration leads to an invasion of threeawn, hairy tridens, broom snakeweed, and annual forbs.

This soil provides limited food and cover for wildlife. Quail, doves, and other ground nesting birds frequent the site.

This Potter soil is in capability subclass VIIs and the Very Shallow range site.

31—Quinlan loam, 1 to 5 percent slopes. This is a shallow, gently sloping soil on uplands. Slopes average about 3 percent. Soil areas are irregularly shaped and range from 30 to 300 acres.

Typically, this soil is calcareous, moderately alkaline, reddish brown loam about 13 inches thick. The underlying material is yellowish red, weakly cemented, calcareous sandstone (fig. 7).

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water capacity is very low. The rooting zone is shallow. The hazards of water erosion and soil blowing are moderate.

Included in mapping are small areas of Burson and Woodward soils. These included soils make up 20 percent or less of a mapped area.

This Quinlan soil is mainly rangeland, but a few areas are in crops. Small grains and forage sorghums are the main crops.

This soil is poorly suited to crops. Shallow rooting depth and slope are the most restrictive features. Crop residues should be kept on the surface to help conserve soil moisture and reduce erosion. Contour farming, terraces, and grassed waterways also control water erosion.

This soil is moderately well suited to rangeland.

This soil is moderately well suited to urban uses. Slope and depth to rock are the most restrictive features, but these are overcome by good design and careful installation procedures. This soil is poorly suited for recreational uses. The surface tends to get dusty with heavy foot traffic, and depth to rock also restricts the use of some areas for playgrounds.

On rangeland the potential plant community consists of mid and short grasses and a variety of forbs and woody plants. Buffalograss and curlymesquite make up about 20 percent of the plant community when the range is in good condition. Sideoats grama makes up about 15 percent; plains bristlegrass, vine-mesquite, Arizona cottontop, and little bluestem make up about 25 percent; and hairy grama, cane and silver bluestem, sand dropseed, hooded windmillgrass, black grama, and purple and Wright threeawns make up about 25 percent. The rest is cool-season grasses, such as Texas wintergrass, Canada wildrye, Hall panicum, and fall witchgrass; forbs, such as Engelmann-daisy, Maximilian sunflower, heath aster, trailing ratany, bundleflower, catclaw sensitivebrier, gaura, prairie-clover, wild alfalfa, sagewort, dotted gayfeather, skeletonplant, buckwheat, and groundcherry; and woody plants, such as littleleaf sumac, skunkbush sumac, bumelia, elbowbush,

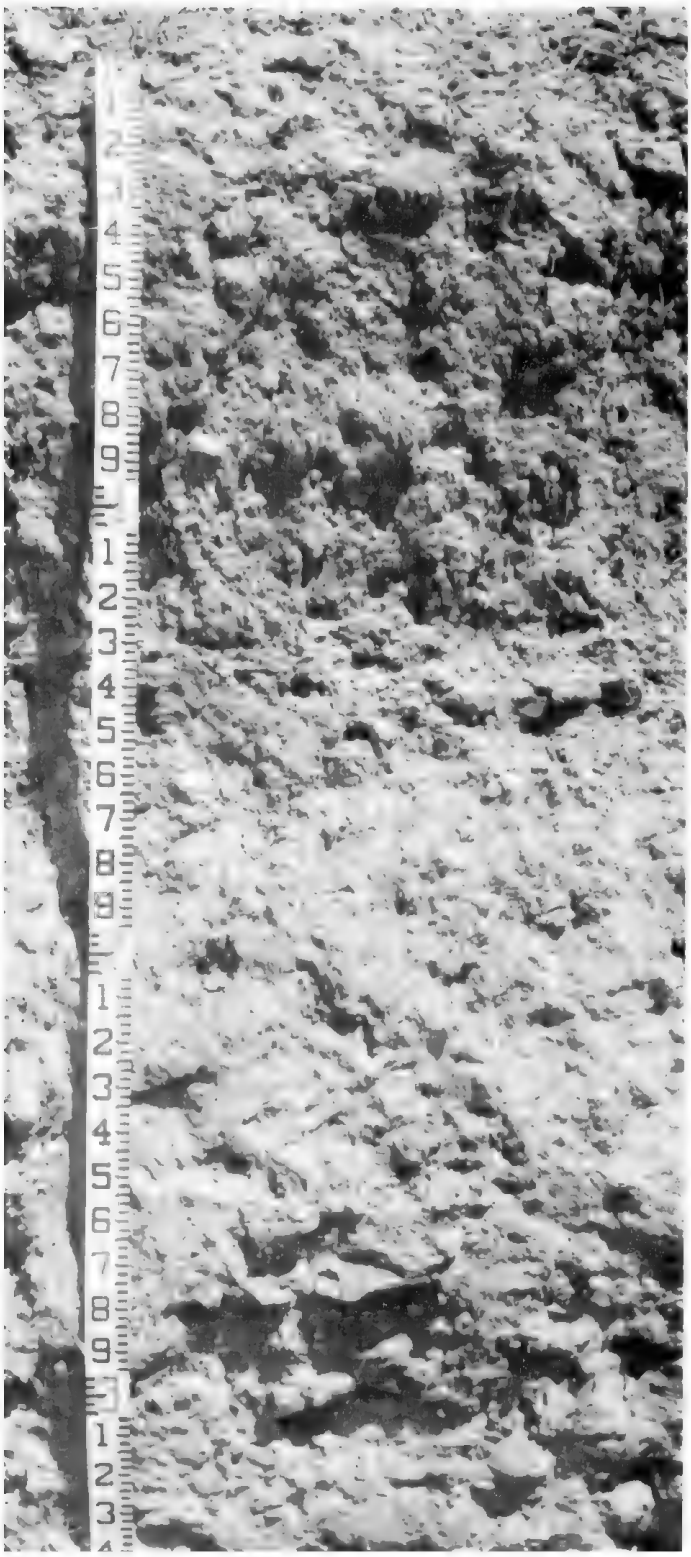


Figure 7.—Profile of Quinlan loam, 1 to 5 percent slopes, showing weakly cemented calcareous sandstone at about 15 inches.

hackberry, dalea, fourwing saltbush; vine ephedra, agarito, wolfberry, catclaw acacia, yucca, and juniper.

As the range deteriorates as a result of heavy grazing, sideoats grama is replaced by buffalograss, sand dropseed, and threeawn. Further heavy grazing leads to an invasion of hairy tridens, red grama, sand muhly, mesquite, juniper, pricklypear, yucca, and tasajillo.

This soil is used heavily by deer, dove, and quail. The plant varieties provide good food and cover for wildlife.

This Quinlan soil is in capability subclass IVe and the Loamy Prairie range site.

32—Quinlan-Burson-Woodward association, rolling. This association is on uplands. It consists of shallow, very shallow, and moderately deep soils. It is about 38 percent Quinlan soil, 36 percent Burson soil, 20 percent Woodward soil, and 6 percent other soils. Slopes range from 5 to 16 percent but average about 8 percent. Areas of this association are irregular in shape and range from 20 to 300 acres.

This association is more variable in composition than other map units in the county. Mapping has been controlled well enough, however, for the anticipated use of the areas involved.

Typically, the Quinlan soil is calcareous, moderately alkaline, reddish brown loam about 11 inches thick. The underlying material is yellowish red, weakly cemented, calcareous sandstone.

Typically, the Burson soil is calcareous, moderately alkaline, red loam about 6 inches thick. The underlying material is red, weakly cemented, calcareous sandstone.

Typically, the Woodward soil has a surface layer of calcareous, moderately alkaline, reddish brown loam about 8 inches thick. The subsoil is moderately alkaline, reddish brown loam about 16 inches thick. The underlying material is red, weakly cemented sandstone.

Other soils included in mapping are small areas of Latom and Paducah soils, areas with 4 inches or less of soil over red beds, and a few barren eroded areas and rock outcrops. These soils and areas make up about 6 percent of the association.

The soils of this association are well drained. Surface runoff is rapid. Permeability is moderate. The available water capacity is very low in the Quinlan and Burson soils and low in the Woodward soil. The rooting zone is moderately deep in the Woodward soil, shallow in the Quinlan soil, and very shallow in the Burson soil. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

These soils are mainly rangeland. They are not suitable for cultivation because of slope, very shallow to shallow rooting depth, and susceptibility to water erosion.

This association is poorly suited to most urban and recreational uses. Slope, depth to rock, and corrosivity to uncoated steel are the most restrictive features, but these can be overcome by good design and careful installation procedures. Depth to rock restricts some playground uses, and the surface tends to get dusty with heavy foot traffic.

Where the Quinlan and Woodward soils are used as rangeland, the potential plant community consists of mid and short grasses and a variety of forbs and woody plants. Buffalograss and curlymesquite make up about 20 percent of the plant community when the range is in good condition. Sideoats grama makes up about 15 percent; plains bristlegrass, vine-mesquite, Arizona cottontop, and little bluestem make up 20 percent; and hairy grama, cane and silver bluestem, sand dropseed, hooded windmillgrass, black grama, and purple and Wright threeawns make up about 25 percent. The rest is cool-season grasses, such as Texas wintergrass, Canada wildrye, Hall panicum, and fall witchgrass; forbs, such as Engelmann-daisy, Maximilian sunflower, heath aster, trailing ratany, bundleflower, catclaw sensitivebrier, gaura, prairie-clover, wild alfalfa, sagewort, dotted gayfeather, skeletonplant, buckwheat, and groundcherry; and woody plants, such as littleleaf sumac, skunkbush sumac, bumelia, elbowbush, hackberry, dalea, fourwing saltbush, vine ephedra, agarito, wolfberry, catclaw acacia, yucca, and juniper.

As the range deteriorates as a result of heavy grazing, sideoats grama is replaced by buffalograss, sand dropseed, and threeawn. Further heavy grazing leads to an invasion of hairy tridens, red grama, sand muhly, mesquite, juniper, pricklypear, yucca, and tasajillo.

Where the Burson soil is used as rangeland, the potential plant community consists of a mixture of tall, mid, and short grasses and a good variety of forbs and woody plants. Sideoats grama makes up about 25 percent of the plant community, and indiangrass, big bluestem, and little bluestem make up about 20 percent. The rest is grasses, such as black grama, cane and silver bluestem, hairy grama, buffalograss, curlymesquite, slim and rough tridens, threeawn, fall witchgrass, Texas wintergrass, and New Mexico feathergrass; forbs, such as dotted gayfeather, rockdaisy, prairie-clover, gaura, bushsunflower, trailing ratany, eveningprimrose, Indian mallow, penstemon, dalea, white sage, and catclaw sensitivebrier; and woody plants, such as littleleaf sumac, skunkbush sumac, vine ephedra, catclaw acacia, wolfberry, agarito, javalinabush, redberry juniper, yucca, and greenbrier.

As the range deteriorates, tall grasses and palatable forbs are replaced by buffalograss, threeawn, slim and rough tridens, and feathery bluestem. Further deterioration leads to an invasion of threeawn, hairy tridens, broom snakeweed, and annual forbs.

This association provides limited food and cover for wildlife. Quail, doves, and other ground-nesting birds frequent the site.

This association is in capability subclass VIe. Quinlan soil is in the Loamy Prairie range site, Burson soil is in the Very Shallow range site, and Woodward soil is in the Loamy Prairie range site.

33—Randall clay. This is a deep, nearly level soil in playas. Slopes are concave and average about 0.3

percent. Soil areas are oval or round and range from 10 to 60 acres. Water is ponded on this soil from 2 days to 1 month each year, except in years of low rainfall.

Typically, this soil is moderately alkaline clay to a depth of about 80 inches. It is dark gray to a depth of about 22 inches, gray to about 53 inches, and grayish brown to about 80 inches.

This soil is somewhat poorly drained. When wet, the soil has very slow permeability; but when dry, it cracks and water enters rapidly. Most standing water on the surface evaporates. The available water capacity is high. The rooting zone is deep. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

Included in mapping are small areas of Roscoe and Rowena soils. Also included are small areas of soils similar to Randall soil that have a light colored surface layer. These included soils make up 10 percent or less of a mapped area.

This Randall soil is used as rangeland and cropland. Cotton and grain sorghum are the main crops.

Yields of cotton or grain sorghum depend mostly on whether or not the soil is flooded during the growing season. If it is not, the crop yields are usually high. Otherwise, they are flooded out. Crop residues should be kept on the soil surface to help control soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Drainage is needed.

This soil is poorly suited to urban and recreational uses. Ponding, very slow permeability, shrinking and swelling, and clayey textures are restrictive features. The potential for recreational uses is low.

On rangeland the potential plant community is variable depending on the length of time the soil is covered with water. Rushes and sedges are dominant in areas ponded for a long time. Perennial grasses and forbs are dominant in areas that are ponded for shorter periods. The dominant perennial grasses are buffalograss, curlymesquite, and vine-mesquite, which make up about half of the potential plant community. White tridens and knotgrass make up about 20 percent of the vegetation, and sedges and annual grasses make up about 15 percent. The rest is perennial forbs, such as prairie coneflower, milkwort, eveningprimrose, and Pennsylvania smartweed.

As the range deteriorates as a result of heavy grazing, permanent grasses and forbs are replaced by annual plants. Some areas become nearly barren.

Migratory waterfowl and other water-loving birds frequent the area when it is covered with water.

This Randall soil is in capability subclass IVw and the Lakebed range site.

34—Roscoe clay. This is a deep, nearly level soil on upland plains. Slopes average about 0.5 percent. Soil areas are oblong and range from 30 to 200 acres. Water is ponded on this soil for 2 to 7 days annually except in years of low rainfall.

Typically, this soil is moderately alkaline clay to a depth of about 75 inches. It is dark gray in the upper 14 inches, gray to a depth of 30 inches, grayish brown to a depth of 45 inches, and light brown in the lower part.

This soil is moderately well drained. Surface runoff is very slow. Permeability is very slow, and the available water capacity is high. The rooting zone is deep. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

Included in mapping are small areas of Randall and Tobosa soils and some small areas of gently sloping Roscoe soil. These included soils make up as much as 20 percent of a mapped area.

This Roscoe soil is mainly cropland, and a few areas are rangeland. Cotton and grain sorghum are the main crops. Sunflowers is a specialty crop adapted to this soil (fig. 8).

This soil is moderately well suited to crops. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also conserve soil moisture.

This soil is poorly suited to urban and recreational uses. Shrinking and swelling, ponding, clayey texture, and corrosivity to uncoated steel are the most restrictive features. Low soil strength is a limitation for roads and streets.

On rangeland the potential plant community consists of short grasses. Typically, tobosa makes up about half of the total vegetation. The rest is grasses, such as alkali sacaton, vine mesquite, buffalograss, curlymesquite, Texas wintergrass, sideoats grama, western wheatgrass, and white tridens in shallow depressions; forbs, such as Indian rushpea, Dakota verbena, and wild onions; and woody plants, such as hackberry, four-wing saltbush, wolfberry, and agarito.

Since tobosa is palatable only for short periods in early spring, heavy grazing throughout the year is dependent on other species. As the range deteriorates, however, tobosa increases and the other species are grazed out. Prolonged heavy year-long grazing results in a dominance of tobosa, buffalograss, and some low-growing, shrubby mesquite.

Quail and doves frequent this area when the annual forbs are seeding. Otherwise, wildlife is scarce.

This Roscoe soil is in capability subclass IIIw and the Clay Flat range site.

35—Rotan clay loam, 0 to 1 percent slopes. This is a deep, nearly level soil on upland plains. Slopes average about 0.5 percent. Soil areas are irregularly shaped and range from 50 to 330 acres.

Typically, this soil has a surface layer of brown clay loam about 9 inches thick. The subsoil extends to a depth of 66 inches or more. It is dark grayish brown clay

Figure 8.—Hybrid sunflowers growing on Roscoe clay.

loam to a depth of about 15 inches, dark grayish brown clay to 24 inches, dark brown clay to 50 inches, and reddish yellow clay loam below that. The soil is typically moderately alkaline throughout.

This soil is well drained. Surface runoff is very slow. Permeability is moderately slow, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazards of water erosion and soil blowing are slight.

Included in mapping are small areas of Sagerton and Rowena soils and some small areas of gently sloping Rotan soils. These included soils make up as much as 15 percent of a mapped area.

This Rotan soil is mainly cropland. Cotton and grain sorghum are the main crops. A few areas are in range.

This soil is well suited to cotton or grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also control water erosion and conserve soil moisture.

This soil is moderately well suited to urban uses. Permeability, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features, but these can be overcome by good design and careful installation procedures. Low soil strength is a limitation for roads and streets. This soil is well suited to recreational uses.

On rangeland the potential plant community consists of short and mid prairie grasses and scattered browse Typically, sideoats grama, buffalograss, tobosa, and vine-mesquite make up 75 percent of the plant community. Arizona cottontop, silver bluestem, white tridens, Texas wintergrass, and sand dropseed make up about 15 percent. The rest is forbs, such as dotted gayfeather, milkvetch, and gaura, and woody plants, such as lotebush, agarito, ephedra, and wolfberry.

As the range deteriorates as a result of heavy grazing, sideoats grama and vine-mesquite decrease and are replaced by tobosa and buffalograss. With further deterioration, buffalograss decreases and mesquite and pricklypear invade the site. Annual forbs, red grama, purple threeawn, and hairy tridens eventually make up most of the vegetation.

This soil produces fair habitat for quail in the form of annual seed plants.

This Rotan soil is in capability subclass IIc and the Clay Loam range site.

36—Rotan clay loam, 1 to 3 percent slopes. This is a deep, gently sloping soil on upland plains. Slopes average about 2 percent. Soil areas are long and narrow and range from 15 to 180 acres.

Typically, this soil has a surface layer of brown clay loam about 8 inches thick. The subsoil extends to a depth of 64 inches or more. It is dark grayish brown clay loam to a depth of about 15 inches, brown clay to a depth of about 45 inches, and below that it is reddish yellow clay that is about 20 percent by volume calcium carbonate. This soil is typically moderately alkaline throughout.

This soil is well drained. Surface runoff is medium. Permeability is moderately slow, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazard of water erosion is moderate, and hazard of soil blowing is slight.

Included in mapping are small areas of Sagerton and Rowena soils and some small areas of nearly level Rotan soils. These included soils make up as much as 20 percent of a mapped area.

This Rotan soil is mainly cultivated, but a few areas are rangeland. Cotton and grain sorghum are the main crops.

This soil is well suited to cotton and grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also help control water erosion.

This soil is moderately well suited to most urban uses. Permeability, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features, but these are easily overcome by good design and careful installation procedures. Low soil strength is a limitation for roads and streets. This soil is well suited to recreational uses.

On rangeland the potential plant community consists of short and mid prairie grasses and scattered browse. Typically, sideoats grama, buffalograss, tobosa, and vine-mesquite make up about 75 percent of the plant community. Arizona cottontop, silver bluestem, white tridens, Texas wintergrass, and sand dropseed make up about 15 percent. The rest is forbs, such as dotted gayfeather, milkvetch, and gaura; and woody plants, such as lotebush, agarito, ephedra, and wolfberry.

As the range deteriorates as a result of heavy grazing, sideoats grama and vine-mesquite decrease and are replaced by tobosa and buffalograss. With further deterioration, buffalograss decreases and mesquite and pricklypear invade the site. Annual forbs, red grama, purple threeawn, and hairy tridens eventually make up most of the vegetation.

This soil provides fair habitat for quail in the form of the annual seed plants.

This Rotan soil is in capability subclass IIe and the Clay Loam range site.

37—Rowena clay loam, 0 to 1 percent slopes. This is a deep, nearly level soil on upland plains. Slopes average about 0.5 percent. Soil areas are oval and irregular in shape and range from 60 to 500 acres.

Typically, the surface layer is dark brown clay loam about 12 inches thick. The subsoil is dark brown clay to a depth of about 28 inches and is brown clay to about 38 inches. The underlying material is pink clay loam to about 55 inches and yellowish red clay loam to about 69 inches. It has common to many soft masses of calcium carbonate. This soil is typically calcareous and moderately alkaline throughout.

This soil is well drained. Surface runoff is slow. Permeability is moderately slow, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazards of water erosion and soil blowing are slight.

Included in mapping are small areas of Rotan and Roscoe soils and some small areas of gently sloping Rowena soils. These included soils make up as much as 20 percent of a mapped area.

This Rowena soil is mainly cropland. Cotton, small grains, and grain sorghum are the main crops (fig. 9). A few areas are rangeland.

This soil is well suited to cotton and grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also help control water erosion and conserve soil moisture.

This soil is poorly suited to most urban uses. Permeability, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features, but these can be overcome by good design and careful installation procedures. Low soil strength is a limitation for roads and streets. This soil is well suited to most recreational uses.

On rangeland the potential plant community consists of short and mid prairie grasses and scattered browse. Typically, sideoats grama, buffalograss, tobosa, and vine-mesquite make up 75 percent of the plant community. Arizona cottontop, silver bluestem, white tridens, Texas wintergrass, and sand dropseed make up about 15 percent. The rest is forbs, such as dotted gayfeather, milkvetch, and gaura, and woody plants, such as lotebush, agarito, ephedra, and wolfberry.

As the range deteriorates as a result of heavy grazing, sideoats grama and vine-mesquite decrease and are replaced by tobosa and buffalograss. With further deterioration, buffalograss decreases and mesquite and pricklypear invade the site. Annual forbs, red grama,

Figure 9.—Area of Rowena clay loam, 0 to 1 percent slopes, in wheat grazed by stocker cattle.

purple threeawn, and hairy tridens eventually make up most of the vegetation.

This soil provides fair habitat for quail in the form of annual seed plants.

This Rowena soil is in capability subclass IIc and the Clay Loam range site.

38—Rowena clay loam, 1 to 3 percent slopes. This is a deep, gently sloping soil on upland plains. Slopes average about 2 percent. Soil areas are long and narrow and range from 15 to several hundred acres.

Typically, this soil has a surface layer of dark brown clay loam about 6 inches thick. The subsoil, to a depth of about 28 inches, is clay that is dark brown in the upper part and brown in the lower part. Below this to a depth of about 60 inches is pink clay loam that is about 60 percent calcium carbonate. This soil is typically calcareous and moderately alkaline throughout.

This soil is well drained. Surface runoff is medium. Permeability is moderately slow, and the available water capacity is high. The rooting zone is deep. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included in mapping are small areas of Mereta and Roscoe soils and some small areas of nearly level Rowena soils. These included soils make up less than 20 percent of a mapped area.

This Rowena soil is mainly cropland. Cotton and grain sorghum are the main crops. A few areas are rangeland.

This soil is well suited to cotton or grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also help control water erosion.

This soil is poorly suited to most urban uses. Permeability, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features, but these can be overcome by good design and careful installation procedures. Low soil strength is a limitation for roads and streets. This soil is well suited to recreational uses. Slope is the most restrictive feature in some areas.

On rangeland the potential plant community consists of short and mid prairie grasses and scattered browse. Typically, sideoats grama, buffalograss, tobosa, and vine-mesquite make up about 75 percent of the plant community. Arizona cottontop, silver bluestem, white tridens, Texas wintergrass, and sand dropseed make up about 15 percent. The rest is forbs, such as dotted gayfeather, milkvetch, and gaura, and woody plants, such as lotebush, agarito, ephedra, and wolfberry.

As the range deteriorates as a result of heavy grazing, sideoats grama and vine-mesquite decrease and are replaced by tobosa and buffalograss. With further deterioration, buffalograss decreases and mesquite and pricklypear invade the site. Annual forbs, red grama, purple threeawn, and hairy tridens eventually make up most of the vegetation.

This soil produces fair habitat for quail in the form of annual seed plants.

This Rowena soil is in capability subclass IIe and the Clay Loam range site.

39—Sagerton clay loam, 0 to 1 percent slopes. This is a deep, nearly level soil on upland plains. Slopes average about 0.5 percent. Soil areas are irregularly shaped and range from 30 to 500 acres.

Typically, this soil has a surface layer of mildly alkaline, brown clay loam about 10 inches thick. The subsoil extends to a depth of 68 inches or more. To a depth of 53 inches, it is clay that is reddish brown and mildly alkaline in the upper part and is moderately alkaline and red in the lower part. Below this, it is calcareous, moderately alkaline, light red clay loam that is about 20 percent by volume calcium carbonate.

This soil is well drained. Surface runoff is slow. Permeability is moderately slow, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazards of water erosion and soil blowing are slight.

Included in mapping are small areas of Rowena and Rotan soils and some small areas of gently sloping Sagerton soils. Also included are areas of a soil similar to Sagerton soil that has a light colored surface layer. These included soils make up as much as 15 percent of a mapped area.

This Sagerton soil is mainly cropland. Cotton and grain sorghum are the main crops. A few areas are rangeland.

This soil is well suited to cotton or grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also help control water erosion and conserve soil moisture.

This soil is moderately well suited to most urban uses. Permeability, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features, but these can be overcome by good design and careful installation procedures. Low soil strength is a limitation for roads and streets. This soil is well suited to recreational uses.

On rangeland the potential plant community consists of short and mid prairie grasses and scattered browse. Typically, sideoats grama, buffalograss, tobosa, and vine-mesquite make up about 75 percent of the plant community. Arizona cottontop, silver bluestem, white tridens, Texas wintergrass, and sand dropseed make up about 15 percent. The rest is forbs, such as dotted gayfeather, milkvetch, and gaura, and woody plants, such as lotebush, agarito, ephedra, and wolfberry.

As the range deteriorates as a result of heavy grazing, sideoats grama and vine-mesquite decrease and are replaced by tobosa and buffalograss. With further deterioration, buffalograss decreases and mesquite and pricklypear invade the site. Annual forbs, red grama, purple threeawn, and hairy tridens eventually make up most of the vegetation.

This soil produces fair habitat for quail in the form of annual seed plants.

This Sagerton soil is in capability subclass IIc and the Clay Loam range site.

40—Sagerton clay loam, 1 to 3 percent slopes. This is a deep, gently sloping soil on upland plains. Slopes average about 2 percent. Soil areas are long and narrow and range from 15 to several hundred acres.

Typically, this soil has a surface layer of reddish brown clay loam about 7 inches thick. The subsoil extends to a depth of 60 inches or more. To a depth of about 34 inches, it is clay that is reddish brown in the upper part and yellowish red in the lower part. To a depth of about 46 inches, it is reddish yellow clay loam that is about 25 percent calcium carbonate. Below this, it is light red clay loam. This soil is typically moderately alkaline throughout.

This soil is well drained. Surface runoff is medium. Permeability is moderately slow, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included in mapping are small areas of Rowena and Rotan soils and some small areas of nearly level Sagerton soils. Also included is a soil similar to this Sagerton soil that has a light colored surface layer. These included soils make up as much as 15 percent of a mapped area.

This Sagerton soil is mainly cropland. Cotton and grain sorghum are the main crops. A few areas are rangeland.

This soil is well suited to cotton or grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also help control water erosion.

This soil is moderately well suited to most urban uses. Permeability, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features, but these are easily overcome by good design and careful installation procedures. Low soil strength is a limitation for roads and streets. This soil is well suited to recreation uses.

On rangeland the potential plant community consists of short and mid prairie grasses and scattered browse. Typically, sideoats grama, buffalograss, tobosa, and vine-mesquite make up about 75 percent of the plant community. Arizona cottontop, silver bluestem, white tridens, Texas wintergrass, and sand dropseed make up about 15 percent. The rest is forbs, such as dotted gayfeather, milkvetch, and gaura, and woody plants, such as lotebush, agarito, ephedra, and wolfberry.

As the range deteriorates as a result of heavy grazing, sideoats grama and vine-mesquite decrease and are

replaced by tobosa and buffalograss. With further deterioration, buffalograss decreases and mesquite and pricklypear invade the site. Annual forbs, red grama, purple threeawn, and hairy tridens eventually make up most of the vegetation.

This soil produces fair habitat for quail in the form of annual seed plants.

This Sagerton soil is in capability subclass IIe and the Clay Loam range site.

41—Shep loam, 1 to 5 percent slopes. This is a deep, gently sloping soil on uplands. Slopes average about 3 percent. Soil areas are long and narrow and range from 100 to 300 acres.

Typically, the surface layer is moderately alkaline, brown loam about 12 inches thick. The subsoil extends to a depth of about 22 inches. It is moderately alkaline, yellowish brown loam. The underlying layer to a depth of 60 inches or more is moderately alkaline, reddish yellow loam that has common soft masses and concretions of calcium carbonate.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazard of water erosion is moderate. The hazard of soil blowing is slight.

Included in mapping are small areas of Nipsum soils and a soil similar to the Shep soils that is siltier throughout. Also included are small areas of sloping Shep soils. These included soils make up as much as 15 percent of a mapped area.

This Shep soil is mainly rangeland. A few areas are used for crops. Small grains and forage sorghum are the main crops.

Yields of forage sorghum and small grains are generally low on this soil. Slopes are steep enough that erosion is a hazard, and this soil can receive runoff from areas upslope. Its high carbonate content also causes chlorosis in most crops. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Contour farming, terraces, diversions, and grassed waterways also help control water erosion.

This soil is well suited to most urban uses. Seepage and corrosivity to uncoated steel are the most restrictive features, but these are easily overcome by good design and careful installation procedures. This soil is well suited to recreational uses. Slope and a dusty surface are restrictions for this use.

On rangeland the potential plant community consists primarily of mid grasses. Typically, sideoats grama and buffalograss make up about 40 percent of the plant community. Little bluestem, plains bristlegrass, Arizona cottontop, and vine-mesquite make up 40 percent. The rest is grasses, such as sand dropseed, hooded windmillgrass, hairy grama, silver bluestem, fall witchgrass, plains lovegrass, and Wright threeawn; forbs, such as catclaw sensitivebrier, halfshrub eveningprimrose, trailing ratany, Engelmann-daisy, gaura, sagewort, dotted gayfeather, western ragweed, and heath aster; and woody plants, such as yucca, catclaw, agarito, hackberry, skunkbush sumac, shin oak, live oak, bumelia, littleleaf sumac, vine ephedra, and sand sagebrush.

As the range deteriorates as a result of heavy grazing, sideoats grama and little bluestem are grazed out and replaced by threeawn, sand dropseed, and buffalograss. Eventually plants such as mesquite trees, pricklypear, condalia, and numerous annuals invade the site.

Where this soil is used for wildlife habitat, birds such as quail and dove frequent the area because of the abundance of seed plants.

This Shep soil is in capability subclass IVe and the Sandy Loam range site.

42—Shep loam, 5 to 12 percent slopes. This is a sloping to strongly sloping soil on uplands. Slopes average about 7 percent. Soil areas are long and narrow and range from 15 to several hundred acres.

Typically, this soil has a surface layer of moderately alkaline, reddish brown loam about 10 inches thick. The subsoil is moderately alkaline, light reddish brown loam to about 38 inches. The underlying material to a depth of about 60 inches is moderately alkaline, pink loam that is about 10 percent by volume calcium carbonate.

This soil is well drained. Surface runoff is rapid. Permeability is moderate, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazard of water erosion is severe, and the hazard of soil blowing is slight.

Included in mapping are small areas of Potter and Nipsum soils. Also included are small areas of gently sloping Shep soils. These included soils make up as much as 30 percent of a mapped area.

This Shep soil is not suited to crops. Slopes are too strong and the hazard of erosion is severe because runoff is received from higher soils upslope. The high carbonate content of the soil causes chlorosis in some plants.

This soil is moderately well suited to most urban and recreational uses. Slope and corrosivity to uncoated steel are the most restrictive features for urban uses. Slope and a dusty surface are restrictions for recreational uses.

On rangeland the potential plant community consists primarily of mid grasses. Typically, sideoats grama and buffalograss make up about 40 percent of the plant community. Little bluestem, plains bristlegrass, Arizona cottontop, and vine-mesquite make up about 40 percent. The rest is grasses, such as sand dropseed, hooded windmillgrass, hairy grama, silver bluestem, fall witchgrass, plains lovegrass, and Wright threeawn; forbs, such as catclaw sensitivebrier, halfshrub eveningprimrose, trailing ratany, Engelmann-daisy, gaura, sagewort, dotted gayfeather, western ragweed, and heath aster; and woody plants, such as yucca, catclaw,

agarito, hackberry, shin oak, live oak, vine ephedra, skunkbush sumac, bumelia, littleleaf sumac, and sand sagebrush.

As the range deteriorates as a result of heavy grazing, sideoats grama, blue grama, and little bluestem are grazed out and replaced by threeawn, sand dropseed, and buffalograss. Eventually plants such as mesquite trees, pricklypear, condalia, and numerous annuals invade the site.

Where this soil is used for wildlife habitat, birds such as quail and dove frequent the area because of the abundance of seed plants.

This Shep soil is in capability subclass VIe and the Sandy Loam range site.

43—Spade loam, 1 to 3 percent slopes. This is a moderately deep, gently sloping soil on uplands. Slopes average about 2 percent. Soil areas are irregularly shaped and range from 30 to 150 acres.

Typically, this soil has a surface layer of brown loam about 6 inches thick. The subsoil, which extends to a depth of about 28 inches, is reddish brown to a depth of about 21 inches and light reddish brown in the lower part. The underlying material is cemented sandstone that has common soft masses of calcium carbonate. This soil is typically moderately alkaline throughout.

This soil is well drained. Surface runoff is medium. Permeability is moderately rapid, and the available water capacity is low. The rooting zone is moderately deep. The hazards of water erosion and soil blowing are moderate.

Included in mapping are small areas of Latom, Cobb, Cosh, and Miles soils. Also included is a soil similar to this Spade soil that has a more clayey subsoil. These included soils make up as much as 20 percent of a mapped area.

This Spade soil is mainly cropland. Small grains and grain sorghum are the main crops. A few areas are rangeland.

This soil is moderately well suited to crops. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Contour farming, terraces, and grassed waterways also help control water erosion.

This soil is moderately well suited to most recreational and urban uses. Depth to rock is the most restrictive feature for urban uses. Depth to rock and a tendency for the surface to get dusty with heavy foot traffic are limitations for recreational uses.

On rangeland the potential plant community consists primarily of mid grasses. Typically, sideoats grama and buffalograss make up about 40 percent of the plant community. Little bluestem, plains bristlegrass, Arizona cottontop, and vine-mesquite make up about 40 percent. The rest is grasses, such as sand dropseed, hooded windmillgrass, hairy grama, silver bluestem, fall witchgrass, plains lovegrass, and Wright threeawn; forbs, such as catclaw sensitivebrier, halfshrub eveningprimrose, trailing ratany, Engelmann-daisy, gaura, sagewort, dotted gayfeather, western ragweed, and heath aster; and woody plants, such as yucca, catclaw, agarito, hackberry, skunkbush sumac, bumelia, littleleaf sumac, and sand sagebrush.

As the range deteriorates as a result of heavy grazing, sideoats grama and little bluestem are grazed out and replaced by threeawn, sand dropseed, and buffalograss. Eventually, plants such as mesquite trees, pricklypear, condalia, and numerous annuals invade the site.

Where this soil is used for wildlife habitat, birds such as quail and dove frequent the area because of the abundance of seed plants.

This Spade soil is in capability subclass IIIe and the Sandy Loam range site.

44—Spade loam, 3 to 5 percent slopes. This is a moderately deep, gently sloping soil on uplands. Slopes average about 3.5 percent. Soil areas are oval and range from 25 to 150 acres.

Typically, this soil has a surface layer of moderately alkaline, brown loam about 8 inches thick. The subsoil, which extends to a depth of about 24 inches, is moderately alkaline, light brown loam. It contains common concretions of calcium carbonate. The underlying material is strongly cemented sandstone.

This soil is well drained. Surface runoff is medium. Permeability is moderately rapid, and the available water capacity is low. The rooting zone is moderately deep. The hazards of water erosion and soil blowing are moderate.

Included in mapping are small areas of Cobb, Cosh, Latom, and Miles soils. Included soils make up as much as 20 percent of a mapped area.

This Spade soil is mainly rangeland. A few areas are used for crops. Small grains and forage sorghum are the main crops.

Yields of small grains and forage sorghum are generally low. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Contour farming, terraces, diversions, and grassed waterways also help control water erosion.

This soil is moderately well suited to most urban and recreational uses. Depth to rock and slope are the most restrictive features. A dusty surface is also a limitation for recreational uses involving foot traffic.

On rangeland the potential plant community consists primarily of mid grasses. Typically, sideoats grama and buffalograss make up about 40 percent of the plant community. Little bluestem, plains bristlegrass, Arizona cottontop, and vine-mesquite make up about 40 percent. The rest is grasses, such as sand dropseed, hooded windmillgrass, hairy grama, silver bluestem, fall witchgrass, plains lovegrass, and Wright threeawn; forbs, such as catclaw sensitivebrier, halfshrub eveningprimrose, trailing ratany, Engelmann-daisy, gaura, sagewort, dotted gayfeather, western ragweed, and

heath aster; and woody plants, such as yucca, catclaw, agarito, hackberry, skunkbush sumac, bumelia, littleleaf sumac, and sand sagebrush.

As the range deteriorates as a result of heavy grazing, sideoats grama and little bluestem are grazed out and replaced by threeawn, sand dropseed, and buffalograss. Eventually plants such as mesquite trees, pricklypear, condalia, and numerous annuals invade the site.

Where this soil is used for wildlife habitat, birds such as quail and dove frequent the area because of the abundance of seed plants.

This Spade soil is in capability subclass IVe and the Sandy Loam range site.

45—Speck clay loam, 0 to 1 percent slopes. This is a shallow, nearly level soil on uplands. Slopes average 0.5 percent. Soil areas are oval and range from 25 to 150 acres.

Typically, this soil has a surface layer of mildly alkaline, reddish brown clay loam about 8 inches thick. The subsoil is mildly alkaline, dark reddish brown clay about 10 inches thick. The underlying material is indurated limestone.

This soil is well drained. Surface runoff is slow. Permeability is slow, and the available water capacity is very low. The rooting zone is shallow. The hazards of erosion and soil blowing are slight.

Included in mapping are small areas of Kavett, Tarrant, and Valera soils. These included soils make up as much as 10 percent of a mapped area.

This Speck soil is mainly rangeland. A few areas are used for crops. Small grains and forage sorghum are the main crops.

Yields of small grains and forage sorghum are generally low. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Contour farming and grassed waterways also help control water erosion; however, when cuts and excavations for waterways are made below a depth of 10 inches, there is a hazard of cutting into limestone bedrock.

This soil is poorly suited to urban and recreational uses. Depth to rock, shrinking and swelling, slow permeability, and corrosivity to uncoated steel are the most restrictive features for urban uses. Slow permeability, clayey texture, and depth to rock are the main restrictions for recreational uses.

On rangeland the potential plant community is a prairie of mid and tall grasses interspersed with mottes of live oak. Typically, little bluestem, big bluestem, and indiangrass make up about 50 percent of the plant community when the range is in good condition. Sideoats grama, tall dropseed, Texas wintergrass, silver bluestem, and vine-mesquite make up about 25 percent. The rest is grasses, such as plains lovegrass, tall dropseed, Texas cupgrass, buffalograss, curlymesquite, fall witchgrass, green sprangletop, and Wright threeawn, and woody plants, such as live oak, elm, hackberry, redbud, bumelia, sumacs, catclaw, agarito, vine ephedra, and bushy honeysuckle.

As the range deteriorates as a result of heavy grazing, big bluestem and indiangrass are replaced by little bluestem, sideoats grama, and vine-mesquite. With continued heavy grazing, these plants are replaced by Texas wintergrass, buffalograss, curlymesquite, shin oak, scrub live oak, juniper, mesquite, lotebush, broomweed, coneflower, nightshades, milkweed, Leavenworth eryngium, Roemer senna, gray goldaster, horehound, evax, Texas grama, hairy tridens, red grama, tumblegrass, and windmillgrass.

Where this soil is used for wildlife habitat, deer inhabit areas with sufficient woody cover for protection.

This Speck soil is in capability subclass IIIs and the Redland range site.

46—Speck clay loam, 1 to 3 percent slopes. This is a shallow, gently sloping soil on uplands. Slopes average about 2 percent. Soil areas are oval and oblong and range from 30 to 150 acres.

Typically, this soil has a surface layer of mildly alkaline, brown clay loam about 7 inches thick. The subsoil is mildly alkaline, reddish brown clay about 11 inches thick. The underlying material is limestone bedrock.

This soil is well drained. Surface runoff is medium. Permeability is slow, and the available water capacity is very low. The rooting zone is shallow. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included in mapping are small areas of Kavett, Valera, and Tarrant soils. Also included are some areas of nearly level Speck soil and areas of a soil similar to the Speck soil that are 20 inches or more deep to bedrock. These included soils make up as much as 15 percent of a mapped area.

This Speck soil is mainly rangeland. A few areas are used for crops. Small grains and forage sorghum are the main crops.

Yields of small grains and forage sorghum are generally low. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Contour farming and grassed waterways are needed to help control water erosion; however, if cuts and excavations for waterways are below a depth of 10 inches, there is a hazard of cutting into limestone bedrock.

This soil is poorly suited to most urban and recreational uses. Depth to rock, shrinking and swelling, slow permeability, clayey texture, and corrosivity to uncoated steel are the most restrictive features for these uses.

On rangeland the potential plant community consists of mid and tall prairie grasses interspersed with mottes of live oak. Typically, little bluestem, big bluestem, and indiangrass make up about 50 percent of the plant community when the range is in good condition. Sideoats

grama, tall dropseed, Texas wintergrass, silver bluestem, and vine-mesquite make up about 25 percent. The rest is grasses, such as plains lovegrass, tall dropseed, Texas cupgrass, bufflograss, curlymesquite, fall witchgrass, green sprangletop, and Wright threeawn, and woody plants, such as live oak, elm, hackberry, redbud, bumelia, sumac, catclaw, agarito, ephedra, and bush honeysuckle.

Vegetation on this soil is more palatable than that on adjoining soils. As the range deteriorates as a result of heavy grazing, big bluestem and indiangrass are replaced by little bluestem, sideoats grama, and vine-mesquite. With further heavy grazing, these plants are replaced by Texas wintergrass, buffalograss, curlymesquite, shin oak, scrub live oak, juniper, mesquite, lotebush, broomweed, coneflowers, nightshade, milkweed, Leavenworth eryngium, Roemer senna, gray goldaster, horehound, evax, Texas grama, hairy tridens, red grama, tumblegrass, and windmillgrass.

Where this soil is used for wildlife habitat, deer inhabit areas where there is sufficient woody cover for protection.

This Speck soil is in capability subclass IIIe and the Redland range site.

47—Tarrant stony clay, 1 to 8 percent slopes. This is a very shallow to shallow, undulating soil on uplands. Slopes average about 4.5 percent. Soil areas are irregularly shaped and range from 200 to several hundred acres.

Typically, the surface layer is dark grayish brown stony clay about 9 inches thick. About 50 to 70 percent of the surface is covered with limestone fragments, which are about half stones, one-quarter cobbles, and one quarter gravel. The next layer is dark brown very cobbly clay about 4 inches thick. Fractured indurated limestone bedrock is at a depth of about 13 inches.

This soil is well drained. Surface runoff is rapid. Permeability is moderately slow, and the available water capacity is very low. The rooting zone is very shallow. The hazard of water erosion is severe, and the hazard of soil blowing is slight.

Included in mapping are small areas of Ector, Kavett, Speck, and Mereta soils. These included soils make up as much as 35 percent of a mapped area.

This Tarrant soil is only rangeland. It is too shallow and stony for cropland (fig. 10).

This soil is poorly suited to most urban and recreational uses. Depth to rock, large stones, and corrosivity to uncoated steel are the most restrictive features; however, the bedrock provides a solid foundation for dwellings and low commercial buildings.

On rangeland the potential plant community is a savanna of mid grass, shin oak, and live oak. Typically, sideoats grama and little bluestem make up about 35 percent of the plant community. Indiangrass and big bluestem make up about 10 percent, and green sprangletop, meadow dropseed, Texas wintergrass, Texas cupgrass, buffalograss, and vine-mesquite make up about 30 percent. The rest is forbs, such as Engelmann-daisy, sagewort, sensitivebrier, bundleflowers, orange zexmenia, sida, bushsunflower, trailing wildbean, and dotted gayfeather, and woody plants, such as shin oak, live oak, redbud, kidneywood, evergreen sumac, flameleaf sumac, skunkbush sumac, hackberry, elbowbush, ephedra, and feather dalea.

As the range deteriorates as a result of heavy grazing, the taller grasses are grazed out and replaced by sod-forming grasses, such as sideoats grama, buffalograss, and curlymesquite. Further heavy grazing results in a cover of juniper, shin oak, Texas grama, red grama, hairy tridens, and threeawn.

Because of the variety of forbs and woody plants, deer frequent the area. Turkeys visit wooded areas of the soil in search of acorns.

This Tarrant soil is in capability subclass VIIs and the Low Stony Hills range site.

48—Texroy loam, 0 to 1 percent slopes. This is a deep, nearly level soil on uplands. Slopes average about 0.5 percent. Soil areas are long and narrow and range from 50 to 150 acres.

Typically, the surface layer is dark brown loam about 8 inches thick. The subsoil extends to a depth of 72 inches or more. It is dark brown loam to a depth of 17 inches, dark brown clay loam to about 24 inches, reddish brown clay loam to about 54 inches, and reddish yellow loam below that. This soil is generally mildly alkaline in the upper part and moderately alkaline in the lower part.

This soil is well drained. Surface runoff is slow. Permeability is moderate, and the available water capacity is high. The rooting zone is deep and easily penetrated by plant roots. The hazards of water erosion and soil blowing are slight.

Included in mapping are small areas of Gageby and Colorado soils. Also included are small areas of soil similar to Texroy soil. One has a dark surface layer 20 inches or less thick, and another has a clayey subsoil. These included soils make up as much as 20 percent of a mapped area.

This Texroy soil is mainly cropland. Cotton, small grains, and grain sorghum are the main crops. A few areas are rangeland.

This soil is well suited to cotton and grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, diversions, and grassed waterways also help control water erosion.

This soil is well suited to most urban uses. Corrosivity to uncoated steel is the most restrictive feature, but this is easily overcome by good design and careful installation procedures. Low soil strength is a limitation for roads and streets.

On rangeland the potential plant community consists

Figure 10.—Area of Tarrant stony clay, 1 to 8 percent slopes.

of short and mid prairie grasses and scattered browse. Typically, blue grama, sideoats grama, buffalograss, tobosa, and vine-mesquite make up about 75 percent of the plant community. Arizona cottontop, silver bluestem, white tridens, Texas wintergrass, and sand dropseed make up about 15 percent. The rest is forbs, such as dotted gayfeather, milkvetch, and gaura, and woody plants, such as lotebush, agarito, ephedra, and wolfberry.

As the range deteriorates as a result of heavy grazing, blue grama, sideoats grama, and vine-mesquite decrease and are replaced by tobosa and buffalograss. With further deterioration, buffalograss decreases and mesquite and pricklypear invade the site. Annual forbs, red grama, purple threeawn, and hairy tridens eventually make up most of the vegetation.

This soil provides fair habitat for quail in the form of annual seed plants.

This Texroy soil is in capability subclass IIc and the Clay Loam range site.

49—Tillman clay loam, 0 to 1 percent slopes. This is a deep, nearly level soil on uplands. Slopes average about 0.5 percent. Soil areas are irregularly shaped and range from 100 to 300 acres.

Typically, the surface layer is reddish brown clay loam about 11 inches thick. The subsoil extends to a depth of 80 inches or more. It is reddish brown clay to a depth of 24 inches, red clay to 43 inches, and red clay loam in the lower part. The soil is moderately alkaline throughout, and the subsoil is calcareous.

This soil is well drained. Surface runoff is slow. Permeability is slow and the available water capacity is high. The rooting zone is deep. The hazards of water erosion and soil blowing are slight.

Included in mapping are small areas of Sagerton and Vernon soils. Also included are several areas of gently sloping Tillman soils. These included soils make up as much as 15 percent of a mapped area.

This Tillman soil is mainly rangeland, but a few areas are used for crops. Cotton and grain sorghum are the main crops.

This soil is moderately well suited to cotton and grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also help control water erosion and conserve soil moisture.

This soil is poorly suited to urban uses. Slow permeability, clayey texture, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features. Low soil strength is a limitation for roads and streets. This soil is moderately well suited to recreational uses. Slow permeability is the main restriction for this use.

On rangeland the potential plant community consists of short and mid prairie grasses and scattered browse. Typically, sideoats grama, buffalograss, tobosa, and vine-mesquite make up about 75 percent of the plant community. Arizona cottontop, silver bluestem, white tridens, Texas wintergrass, and sand dropseed make up about 15 percent. The rest is forbs, such as dotted gayfeather, milkvetch, and gaura, and woody plants, such as lotebush, agarito, ephedra, and wolfberry.

As the range deteriorates as a result of heavy grazing, sideoats grama and vine-mesquite decrease and are replaced by tobosa and buffalograss. With further deterioration, buffalograss decreases and mesquite and pricklypear invade the site. Annual forbs, red grama, purple threeawn, and hairy tridens eventually make up most of the vegetation.

This soil provides fair habitat for quail in the form of annual seed plants.

This Tillman soil is in capability subclass IIs and the Clay Loam range site.

50—Tobosa clay, 0 to 1 percent slopes. This is a deep, nearly level soil on uplands. Slopes average about 0.5 percent (fig. 11). Soil areas are irregularly shaped and range from 50 to 200 acres.

Typically, the surface layer is moderately alkaline, dark grayish brown clay 28 inches thick. The next layer, which extends to a depth of about 45 inches, is moderately alkaline, brown clay. The underlying layer to a depth of 64 inches or more is moderately alkaline, light brown clay that is about 13 percent, by volume, calcium carbonate. In some places limestone bedrock is below a depth of 50 inches.

This soil is well drained. Surface runoff is slow. Permeability is very slow, and the available water capacity is high. The rooting zone is deep. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

Included in mapping are small areas of Roscoe and Rowena soils and small areas of gently sloping Tobosa soils. These included soils make up less than 15 percent of a mapped area.

Figure 11.—Area of Tobosa clay, 0 to 1 percent slopes, in the Clay Flat range site.

This Tobosa soil is mainly cropland. Cotton and grain sorghum are the main crops. A few areas are rangeland.

This soil is moderately well suited to cotton and grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also help control water erosion and conserve soil moisture.

This soil is poorly suited to most urban uses. Very slow permeability, clayey texture, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features. Low soil strength is a limitation for roads and streets. This soil is moderately well suited to recreational uses. Permeability and clayey surfaces are restrictions for this use.

On rangeland the potential plant community is short grass. Typically, tobosa makes up about half of the total plant community. The rest is grasses, such as alkali sacaton, vine-mesquite, buffalograss, Texas wintergrass, sideoats grama, and western wheatgrass, and white tridens in shallow depressions; forbs, such as Indian

rushpea, Dakota verbena, and wild onion; and woody plants, such as hackberry, four-wing saltbush, wolfberry, and agarito.

Since tobosa is palatable only for short periods in early spring, heavy grazing throughout the year is dependent on the other species. Therefore, as the range deteriorates, tobosa increases while other species are grazed out. Prolonged heavy year-long grazing results in a dominance of tobosa, buffalograss, and some low-growing, shrubby mesquite.

Quail and doves frequent areas of this soil when the annual forbs are seeding. At other times, wildlife is scarce.

This Tobosa soil is in capability subclass IIIs and the Clay Flat range site.

51—Tobosa clay, 1 to 3 percent slopes. This is a deep, gently sloping soil on uplands. Slopes average about 2 percent. Soil areas are irregularly shaped and range from 20 to 150 acres.

Typically, this soil has a surface layer of moderately alkaline, dark grayish brown clay about 6 inches thick. To a depth of 60 inches or more, it is moderately alkaline clay that is dark brown in the upper part, brown in the middle part, and light yellowish brown in the lower part. In some places limestone bedrock is at a depth of 50 inches.

This soil is well drained. Surface runoff is medium. Permeability is very slow, and the available water capacity is high. The rooting zone is deep. The hazards of water erosion and soil blowing are moderate.

Included in mapping are small areas of Roscoe and Rowena soils and some areas of nearly level Tobosa soil. These included soils make up as much as 15 percent of a mapped area.

This Tobosa soil is mainly cropland. Cotton and grain sorghum are the main crops. A few areas are rangeland.

This soil is moderately well suited to cotton and grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also help control water erosion.

This soil is poorly suited to most urban uses. Very slow permeability, clayey texture, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features. Low soil strength is a limitation for streets and roads. This soil is moderately well suited to recreational uses. Permeability and clayey texture are restrictions for this use.

On rangeland the potential plant community is short grass. Typically, tobosa makes up about half of the total plant community. The rest is grasses, such as alkali sacaton, vine-mesquite, buffalograss, Texas wintergrass, sideoats grama, and western wheatgrass, and white tridens in shallow depressions; forbs, such as Indian rushpea, Dakota verbena, and wild onion; and woody plants, such as hackberry, four-wing saltbush, wolfberry, and agarito.

Since tobosa is palatable only for short periods in early spring, heavy grazing throughout the year is dependent on the other species. As the range deteriorates, however, tobosa increases while other species are grazed out. Prolonged heavy year-long grazing results in a dominance of tobosa, buffalograss, and some low-growing, shrubby mesquite.

Quail and doves frequent areas of this soil during the time annual forbs are seeding. Otherwise, wildlife is scarce.

This Tobosa soil is in capability subclass IIIe and the Clay Flat range site.

52—Valera silty clay, 0 to 1 percent slopes. This is a moderately deep, nearly level soil on uplands. Slopes average about 0.5 percent. Soil areas are irregularly shaped and range from 20 to 80 acres.

Typically, this soil has a surface layer of moderately alkaline dark grayish brown silty clay about 17 inches thick. The subsoil, which extends to a depth of about 37 inches, is moderately alkaline silty clay that is dark brown in the upper part and brown in the lower part. The underlying material is strongly cemented caliche about 2 inches thick. It is underlain by indurated limestone bedrock.

This soil is well drained. Surface runoff is slow. Permeability is moderately slow, and the available water capacity is low. The rooting zone is moderately deep. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

Included in mapping are small areas of Kavett and Tobosa soils and small areas of gently sloping Valera soils. These included soils make up as much as 20 percent of a mapped area.

This Valera soil is mainly rangeland, but a few areas are used for crops. Small grains and forage sorghum are the main crops.

This soil is moderately well suited to small grains and forage sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also help control water erosion.

This soil is poorly suited to most urban uses. Depth to rock, permeability, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features, but these can be overcome by proper design and installation. Low soil strength is a limitation for roads and streets. This soil is moderately well suited to recreational uses. Clayey texture is a restriction for this use.

On rangeland the potential plant community consists of short and tall grasses with limited amounts of tall grass in the slightly lower areas. Grasses, which make

up 75 percent of the total vegetation, include sideoats grama, little bluestem, indiangrass, buffalograss, silver bluestem, meadow dropseed, vine-mesquite, and Texas wintergrass. The rest is forbs, such as dotted gayfeather, gaura, bundleflower, eveningprimrose, and sagewort; and browse plants, such as vine ephedra, wolfberry, lotebush, hackberry, pricklyash, bumelia, and western soapberry.

As the range deteriorates as a result of heavy grazing, indiangrass, little bluestem, sideoats grama, and vine-mesquite are grazed out while buffalograss increases. Continued heavy grazing results in an invasion of mesquite trees, juniper, pricklypear, annual forbs, threeawn, hairy tridens, and Texas grama.

This soil provides habitat for quail and doves. Deer use the more brushy areas for protective cover.

Valera soil is in capability subclass IIs and the Clay Loam range site.

53—Valera silty clay, 1 to 3 percent slopes. This is a moderately deep, gently sloping soil on uplands. Slopes average about 2 percent. Soil areas are long and narrow and range from 25 to 100 acres.

Typically, this soil has a surface layer of moderately alkaline, dark brown silty clay about 21 inches thick. The subsoil is moderately alkaline, dark brown silty clay about 4 inches thick. The underlying material is strongly cemented caliche about 2 inches thick. It is underlain by fractured indurated limestone.

This soil is well drained. Surface runoff is medium. Permeability is moderately slow, and the available water capacity is low. The rooting zone is moderately deep. The hazards of water erosion and soil blowing are moderate.

Included in mapping are small areas of Kavett and Tobosa soils and small areas of nearly level Valera soil. These included soils make up as much as 20 percent of a mapped area.

The Valera soil is mainly rangeland, but a few areas are used for crops. Small grains and forage sorghum are the main crops.

This soil is moderately well suited to small grains and grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, and grassed waterways also control water erosion.

This soil is poorly suited to most urban uses. The moderately slow permeability, depth to rock, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features. These can be overcome, however, by proper design and installation measures. Low soil strength is a limitation for roads and streets. A clayey texture is a restriction for recreational uses.

On rangeland the potential plant community consists of short and mid grasses with limited amounts of tall grass in the slightly lower areas. Grasses, which make up 70 percent of the plant community, are sideoats grama, little bluestem, indiangrass, buffalograss, silver bluestem, meadow dropseed, vine-mesquite, and Texas wintergrass. The rest is forbs, such as dotted gayfeather, gaura, bundleflower, eveningprimrose, and sagewort; and browse plants, such as ephedra, wolfberry, lotebush, hackberry, pricklyash, bumelia, and western soapberry.

As the range deteriorates as a result of heavy grazing, indiangrass, little bluestem, sideoats grama, and vine-mesquite tend to be grazed out while buffalograss increases. Continued heavy grazing results in an invasion of mesquite trees, juniper, pricklypear, annual forbs, threeawn, hairy tridens, and Texas grama.

This soil provides habitat for quail and doves. Deer occasionally use the more brushy areas for protective cover.

This Valera soil is in capability subclass IIe and the Clay Loam range site.

54—Veal loam, 1 to 5 percent slopes. This is a deep, gently sloping soil on upland plains. Slopes average about 3 percent. Soil areas are long and narrow and range from 30 to several hundred acres.

Typically, the surface layer is brown loam about 10 inches thick. The subsoil extends to a depth of 60 inches or more. To a depth of about 18 inches, it is pale brown clay loam that is about 25 percent by volume calcium carbonate. To about 40 inches, it is very pale brown clay loam that is 50 percent by volume calcium carbonate. Below this, it is white loam that is about 10 percent soft masses of calcium carbonate.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water capacity is medium. The rooting zone is deep and easily penetrated by plant roots. The hazards of erosion and soil blowing are moderate.

Included in mapping are small areas of Rowena and Potter soils and small areas of sloping Veal soil. Also included are soils similar to the Veal soils that have a siltier subsoil or a dark colored surface layer. These included soils make up as much as 30 percent of a mapped area; however, since most are closely similar to the Veal soil, they respond to similar use and management.

This Veal soil is mainly cropland. Cotton, grain sorghum, and small grains are the main crops. A few areas are rangeland.

Crop yields are generally low on this soil. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Contour farming, terraces, and grassed waterways also help control water erosion.

This soil is well suited to most urban and recreational uses. Slope is the most restrictive feature. Low soil strength is a limitation for roads and streets. These limitations are easily overcome by good design and careful installation.

On rangeland the potential plant community is mid and short grasses and a variety of forbs. Typically, sideoats grama makes up about 30 percent of the vegetation, buffalograss makes up about 20 percent, and cane and silver bluestems make up about 15 percent. The rest is grasses, such as vine-mesquite, plains bristlegrass, Texas wintergrass, hooded windmillgrass, Hall panicum, sand dropseed, bush muhly, and fall witchgrass; forbs, such as Engelmann-daisy, bushsunflower, heath aster, rockdaisy, wild alfalfa, globemallow, gaura, groundcherry, verbena, dotted gayfeather, prairie-clover, trailing wildbean, clematis, skeletonplant, plains zinnia, and catclaw sensitivebrier; and woody plants, such as hackberry, littleleaf sumac, fourwing saltbush, dalea, yucca, wolfberry, and catclaw acacia.

As the range deteriorates, sideoats grama and little bluestem are replaced by buffalograss and feathery bluestem. Further deterioration leads to an invasion of threeawn and annuals. Mesquite is not prominent on this site. In its poorest condition broom snakeweed and pricklypear eventually dominate the site.

This soil furnishes a good food supply for quail and many nongame birds.

The Veal soil is in capability subclass IVe and the Loamy range site.

55—Vernon clay, 1 to 3 percent slopes. This is a moderately deep, gently sloping soil on uplands. Slopes average about 2 percent. Soil areas are irregularly shaped and range from 50 to 300 acres.

Typically, this soil has a surface layer of moderately alkaline, reddish brown clay about 12 inches thick. The subsoil, which extends to a depth of 31 inches, is moderately alkaline, red clay. The underlying material is red shaly clay.

This soil is well drained. Surface runoff is rapid. Permeability is very slow, and the available water capacity is low. The rooting zone is moderately deep. The hazards of erosion and soil blowing are moderate.

Included in mapping are some areas of Knoco and Tillman soils. Also included are areas of soils that are closely similar to the Vernon soil but are either more than 36 inches or less than 20 inches deep to shaly clay. These included soils make up as much as 15 percent of a mapped area.

This Vernon soil is mainly rangeland, but a few areas are used for crops. Small grains and grain sorghum are the main crops.

Yields of small grains and grain sorghum are generally low on this soil. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Contour farming, terraces, diversions, and grassed waterways also help control water erosion.

This soil is poorly suited to most urban uses. Shrinking and swelling, very slow permeability, clayey texture, and corrosivity to uncoated steel are the most restrictive features. Low soil strength is a limitation for roads and streets. This soil is moderately well suited to recreational uses. Permeability and a clayey texture are restrictions for this use.

On rangeland the potential plant community consists of short and mid prairie grasses. Typically, sideoats grama, alkali sacaton, and tobosa make up about 45 percent of the plant community when the range is in good condition. Buffalograss and curlymesquite make up about 15 percent. The rest is grasses, such as cane and silver bluestem, vine-mesquite, little bluestem, Texas wintergrass, slim and rough tridens, white tridens, hairy grama, and perennial threeawn; forbs, such as wild alfalfa, buckwheat, Indian rushpea, dalea, prairie-clover, dotted gayfeather, gaura, Engelmann-daisy, catclaw sensitivebrier, and scurfpea; and woody plants, such as vine ephedra, wolfberry, catclaw acacia, yucca, and fourwing saltbush.

As the range deteriorates as a result of heavy grazing, sideoats grama is replaced by buffalograss and tobosa. Further deterioration leads to an invasion of hairy tridens, Texas grama, sand muhly, mesquite, pricklypear, juniper, and condalia. When the range is in its poorest condition, this soil produces annual grasses and forbs or the ground is bare.

This soil is rated fair for wildlife habitat. Because of sparse cover and food, wildlife is scarce on this site. There are a few dove and quail in some places. Deer are not attracted to the site because it has sparse woody cover.

This Vernon soil is in capability subclass IVe and the Shallow Clay range site.

56—Volente-Gageby complex, 0 to 5 percent slopes. This complex consists of deep, nearly level soils in valleys (fig. 12). It is about 60 percent Volente soils on foot slopes above the flood plain, 28 percent Gageby soils on the flood plain, and 12 percent other soils. Slopes range from 0 to 5 percent on the Volente soil and from 0 to 2 percent on the Gageby soil. Areas of the complex are long and narrow and range from 15 to 200 acres. The Gageby soil is inundated annually for periods of 2 days or less.

This complex is more variable in composition than other map units in the county. These soils are so intricately mixed that it is not practical to map them separately at the scale used.

Typically, the Volente soils have a surface layer of dark grayish brown clay loam about 24 inches thick. The subsoil, which extends to a depth of about 38 inches, is brown clay loam. The underlying material is about 4 inches of pale brown clay loam that is about 20 percent, by volume, limestone fragments. Limestone bedrock is at a depth of about 42 inches. This soil is moderately alkaline throughout.

Typically, the Gageby soil has a surface layer of dark grayish brown clay loam about 22 inches thick. The next layer extends to a depth of about 44 inches. It is grayish brown clay loam that is about 10 percent, by volume,

Figure 12.—Area of Volente-Gageby complex, 0 to 5 percent slopes, with Ector soils in the background.

angular limestone gravel. The subsoil, which extends to a depth of about 60 inches, is brown clay loam. This soil is moderately alkaline throughout.

Both soils in this complex are well drained. Surface runoff is medium. Permeability is moderately slow in the Volente soil and moderate in the Gageby soil. The available water capacity is medium. The rooting zone is deep and easily penetrated by plant roots. The hazard of erosion is moderate, and the hazard of soil blowing is slight.

Included in the mapping of this complex are areas of Tarrant, Kavett, and Tobosa soils. Also included are areas of gravelly alluvial material. Inclusions make up 5 to 30 percent of a mapped area.

This complex is mainly rangeland. A few areas are used for crops. Most soil areas are too narrow to be practical for tillage. Small grains and grain sorghum are the main crops.

These soils are moderately well suited to small grains and grain sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. Contour farming, terraces, and grassed waterways also control water erosion. Diversion terraces are needed to control runoff water from higher slopes.

These soils are poorly suited to most urban uses. Slope, shrinking and swelling, and corrosivity to uncoated steel are the most restrictive features. Low soil strength is a limitation for roads and streets. There is a hazard of flooding on the Gageby soil. These soils are moderately well suited to recreational uses. Slope and flooding are restrictions for this use.

Where the Volente soil is used as rangeland, the potential plant community consists of short and mid grasses with limited amounts of tall grass in the slightly lower areas. Grasses, such as sideoats grama, little bluestem, indiangrass, buffalograss, silver bluestem, meadow dropseed, vine-mesquite, and Texas wintergrass, make up about 75 percent of the plant community. The rest is forbs, such as dotted gayfeather, gaura, bundleflower, eveningprimrose, and sagewort, and browse plants, such as ephedra, wolfberry, lotebush, hackberry, pricklyash, bumelia, and western soapberry.

As the range deteriorates as a result of heavy grazing, indiangrass, little bluestem, sideoats grama, and vine-mesquite tend to be grazed out while buffalograss increases. Continued heavy grazing results in an invasion of mesquite trees, pricklypear, annual forbs, threeawn, hairy tridens, and Texas grama.

Where the Gageby soil is used as rangeland, the potential plant community consists primarily of mid grasses and scattered tall grasses. Typically, vine-mesquite makes up about 20 percent of the total potential vegetation and sideoats grama makes up about 15 percent. About 40 percent of the potential plant community is Arizona cottontop, plains bristlegrass, cane and silver bluestem, alkali sacaton, Texas wintergrass, blue grama, meadow dropseed, and white tridens. The rest is grasses, such as tobosa and scattered tall grasses, western wheatgrass, cool-season grasses, and sedges; forbs, such as, Engelmann-daisy, bushsunflower, Maximilian sunflower, heath aster, dotted gayfeather, bundleflower, gaura, verbena, sagewort, trailing ratany, greenthread, eveningprimrose; and western ragweed; and woody plants, such as hackberry, elm, bumelia, vine ephedra, fourwing saltbush, wolfberry, pricklyash, catclaw acacia, western soapberry, and bois d'arc.

As the range deteriorates as a result of heavy grazing, the mid grasses decrease and are replaced by buffalograss, Texas wintergrass, and meadow dropseed. Further heavy grazing leads to an invasion of mesquite, juniper, pricklypear, and annual grasses.

This complex provides good habitat for deer, turkey, dove, and quail. Most of the plants produced are valuable cover or food for wildlife.

This complex is in capability subclass IIIe. The Volente soil is in Clay Loam range site and the Gageby soil is in the Draw range site.

57—Woodward loam, 1 to 3 percent slopes. This is a moderately deep, gently sloping soil on uplands. Slopes average about 2 percent. Soil areas are irregularly shaped and range from 20 to 50 acres.

Typically, this soil has a surface layer of moderately alkaline, reddish brown loam about 8 inches thick. The subsoil extends to a depth of 31 inches. It is moderately alkaline, reddish brown loam. The underlying material is weakly cemented red-bed sandstone.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water capacity is low. The rooting zone is moderately deep and easily penetrated by plant roots. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included in mapping are small areas of Quinlan and Paducah soils. Also included are areas of a soil closely similar to the Woodward soil that has a clay loam subsoil. These included soils make up as much as 30 percent of a mapped area.

This Woodward soil is mainly rangeland, but a few areas are used for crops. Small grains and forage sorghum are the main crops.

This soil is moderately well suited to small grains and forage sorghum. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, diversions, and grassed waterways also help control water erosion.

This soil is moderately well suited to most urban and recreational uses. Depth to rock is the most restrictive feature, but this is easily overcome by good design and careful installation. Low soil strength is a limitation for roads and streets. A dusty surface is a limitation to its use for playgrounds.

On rangeland the potential plant community consists of mid and short grasses and a variety of forbs and woody plants. Buffalograss and curlymesquite make up about 20 percent of the plant community when the range is in good condition. Sideoats grama makes up about 15 percent; plains bristlegrass, vine-mesquite, Arizona cottontop, and little bluestem make up about 25 percent; and hairy grama, cane and silver bluestem, sand dropseed, hooded windmillgrass, black grama, and purple and Wright threeawn make up about 25 percent. The rest is cool-season grasses, such as Texas wintergrass, Canada wildrye, Hall panicum, and fall witchgrass; forbs, such as Engelmann-daisy, Maximilian sunflower, heath aster, trailing ratany, bundleflower, catclaw sensitivebrier, gaura, prairie-clover, wild alfalfa, sagewort, dotted gayfeather, skeletonplant, buckwheat, and groundcherry; and woody plants, such as littleleaf sumac, skunkbush sumac, bumelia, hackberry, dalea, fourwing saltbush, vine ephedra, agarito, wolfberry, catclaw acacia, yucca, and juniper.

As the range deteriorates as a result of heavy grazing, sideoats grama and blue grama are replaced by buffalograss, sand dropseed, and threeawn. Further heavy grazing leads to an invasion of hairy tridens, red grama, sand muhly, mesquite, juniper, pricklypear, yucca, and tasajillo.

These areas are used heavily by deer, dove, and quail. The many plant varieties provide good food and cover for wildlife.

This Woodward soil is in capability subclass IIe and the Loamy Prairie range site.

58—Woodward loam, 3 to 5 percent slopes. This is a moderately deep, gently sloping soil on uplands. Slopes average about 3.5 percent. Soil areas are irregularly shaped and range from 25 to 150 acres.

Typically, this soil has a surface layer of moderately alkaline, brown loam about 7 inches thick. The subsoil extends to a depth of 31 inches. It is moderately alkaline, brown loam that grades to reddish yellow in the lower part. The underlying material is weakly cemented, red-bed sandstone.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and the available water capacity is low. The rooting zone is moderately deep and easily penetrated by plant roots. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included in mapping are small areas of Quinlan and Paducah soils and also small areas of gently sloping

Woodward soils. These included soils make up as much as 20 percent of a mapped area.

This Woodward soil is mainly rangeland, but a few areas are used for crops. Small grains and forage sorghum are the main crops.

Yields of small grains and forage sorghum are generally low on this soil. Crop residues should be kept on the soil surface to help control water erosion and soil blowing, and also to conserve soil moisture. In dry years, emergency tillage is needed to control soil blowing if crop residues do not furnish adequate protection. Contour farming, terraces, diversions, and grassed waterways also help control water erosion.

This soil is moderately well suited to most urban and recreational uses. Depth to rock and slope are the most restrictive features, but these are easily overcome by good design and careful installation. Low soil strength is a limitation for roads and streets. Slope and a dusty surface are limitations for some recreational uses.

On rangeland the potential plant community consists of mid and short grasses and a variety of forbs and woody plants. Sideoats grama, buffalograss, and curlymesquite make up about 35 percent of the plant community when the range is in good condition. Texas wintergrass makes up about 15 percent; plains bristlegrass, vine-mesquite, Arizona cottontop, and little bluestem make up about 20 percent; and hairy grama, cane and silver bluestem, sand dropseed, hooded windmillgrass, and purple and Wright threeawns make up about 15 percent. The rest is cool-season grasses, such as Canada wildrye, Hall panicum, and fall witchgrass; forbs, such as Engelmann-daisy, Maximilian sunflower, heath aster, trailing ratany, bundleflower, catclaw sensitivebrier, gaura, prairie-clover, wild alfalfa, sagewort, dotted gayfeather, skeletonplant, buckwheat, and groundcherry; and woody plants, such as littleleaf sumac, skunkbush sumac, bumelia, elbowbush, hackberry, dalea, fourwing saltbush, vine ephedra, agarito, wolfberry, catclaw acacia, yucca, and juniper.

As the range deteriorates as a result of heavy grazing, sideoats grama is replaced by buffalograss, sand dropseed, and threeawn. Further heavy grazing leads to an invasion of hairy tridens, red grama, sand muhly, mesquite, juniper, pricklypear, yucca, and tasajillo.

This soil is used heavily by deer, dove, and quail. The many plant varieties provide good food and cover for wildlife.

This Woodward soil is in capability subclass IIIe and the Loamy Prairie range site.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 142,000 acres in Nolan County are used for crops. There are approximately 48,000 acres in cotton; 38,000 acres in small grains; and 13,000 acres in grain sorghum. The remaining acres produce forage for livestock.

Most of the arable land is in crops. Most of the remaining arable rangeland is either not accessible to farm equipment or is located on large ranches committed to raising livestock. Land use in the county has remained stable since about 1960.

Fertility is naturally high in most soils in the county; however, commercial fertilizers that include nitrogen and phosphorus are added to most cultivated crops. For wheat, nitrogen and phosphorus are applied at planting time, and nitrogen is again applied as a top dressing late in winter. For most row crops, nitrogen is applied late in winter or early in spring before planting.

Water erosion is a minor problem in the county. Most of the gently sloping areas used for row crops are terraced and cultivated on the contour. Gently sloping areas that are not terraced are planted in small grains. Crop residue left on the surface slows runoff and helps to control erosion. Gently sloping areas of the Cobb, Miles, Paducah, Rowena, Sagerton, and Woodward soils are subject to water erosion. Terraces and diversions reduce the length of slope, slow runoff, and help control erosion.

Soil blowing is a major problem on Cobb, Miles, Paducah, and Woodward soils. A cropping system that maintains a vegetative cover or keeps crop residue on the surface for extended periods reduces soil blowing and maintains tilth and productivity.

About 2,200 acres are irrigated by supplemental type systems that were installed during the mid-1950's. Most of these are sprinkler type irrigation systems. The irrigated crops are mostly cotton and grain sorghum.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension

agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed soil map units."

rangeland

Dan Caudle, area range conservationist, Soil Conservation Service, helped prepare this section.

Rangeland is the main land use in Nolan County. It covers approximately 420,000 acres, or 71 percent, of the total survey area. Most of the local ranches and livestock farms are primarily cow-calf operations. There are also some stocker calf enterprises, and many

ranches supplement their cow herds with stockers, sheep, or goats. Sheep and goats have traditionally been an important part of the ranching industry in Nolan County.

Most livestock ranching operations, which depend mainly on range grasses for forage, include some cropland. The cropland is used for supplemental grazing and hay. Major forage and hay crops include sorghums and small grains. Improved pastures that consist mainly of kleingrass, weeping lovegrass, and improved bermudagrass have become an integral part of many livestock operations.

Most rangeland in this area has been heavily grazed since the introduction of domestic livestock and barbed wire fences. As a result, most of the more palatable grasses have been grazed out and replaced by short grasses and weeds. The treeless prairies in many places now support dense stands of mesquite and other brush. Remnants of the original plant community, however, can still be found in protected spots on even the most deteriorated grasslands. In such areas good grazing management makes it possible for high quality plants to reestablish themselves.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 8 shows, for each soil, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. Only those soils that are used as or are suited to rangeland are listed. An explanation of the column headings in table 8 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

The grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed by common name in the map unit descriptions.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

About 50 percent of Nolan County is used for deer, quail, and dove hunting. Lake Sweetwater and Lake Trammell provide fishing, camping, and other water-related activities. There are two golf courses and many parks and playgrounds located throughout the county.

The geologic features of Nolan County are unique. The many different rock formations within just a few miles produce landscapes ideal for hiking, camping, and other forms of outdoor recreation.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

Willard E. Richter, biologist, Soil Conservation Service, helped prepare this section.

Land managed for wildlife habitat is an important source of recreation and income in Nolan County. As the demand for recreation increases, landowners devote more lands to primary and secondary use for this purpose. Such management involves maintaining, improving, and developing the elements of food, cover, and water required by the various wildlife species in the county.

Both game and nongame species of wildlife exist in the county. The nongame species are numerous songbirds, raptors, amphibians, reptiles, and rodents. Also included are waterfowl, such as herons, egrets, and gallinules.

The game species can be divided into three categories: small game including the furbearers, big game, and waterfowl.

Small game includes turkey, bobwhite quail, scaled quail, dove, cottontail, jackrabbit, and fox squirrel. Furbearers are raccoon, opossum, skunk, ringtail cat, coyote, fox, and bobcat. Big game is limited to white-tailed deer, a few antelope, and some exotic species found on private shooting preserves, such as blackbuck antelope, axis deer, fallow deer, and sika deer. Waterfowl are ducks, geese, and sandhill cranes.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and

abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, millet, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, kleingrass, clover, winter peas, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, croton, ragweed, sunflower, and grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are agarito, shin oak, sand plum, and skunkbush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, panicum, wildrice, saltgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include quail, sandhill crane, meadowlark, field sparrow, cottontail, prairie dog, and red fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, shore birds, nutria, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, turkey, meadowlark, and lark bunting.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply

only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic

matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 13 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit

revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 15 gives information on the soil properties and site features that affect water management. The degree

and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping (fig. 13), and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium.

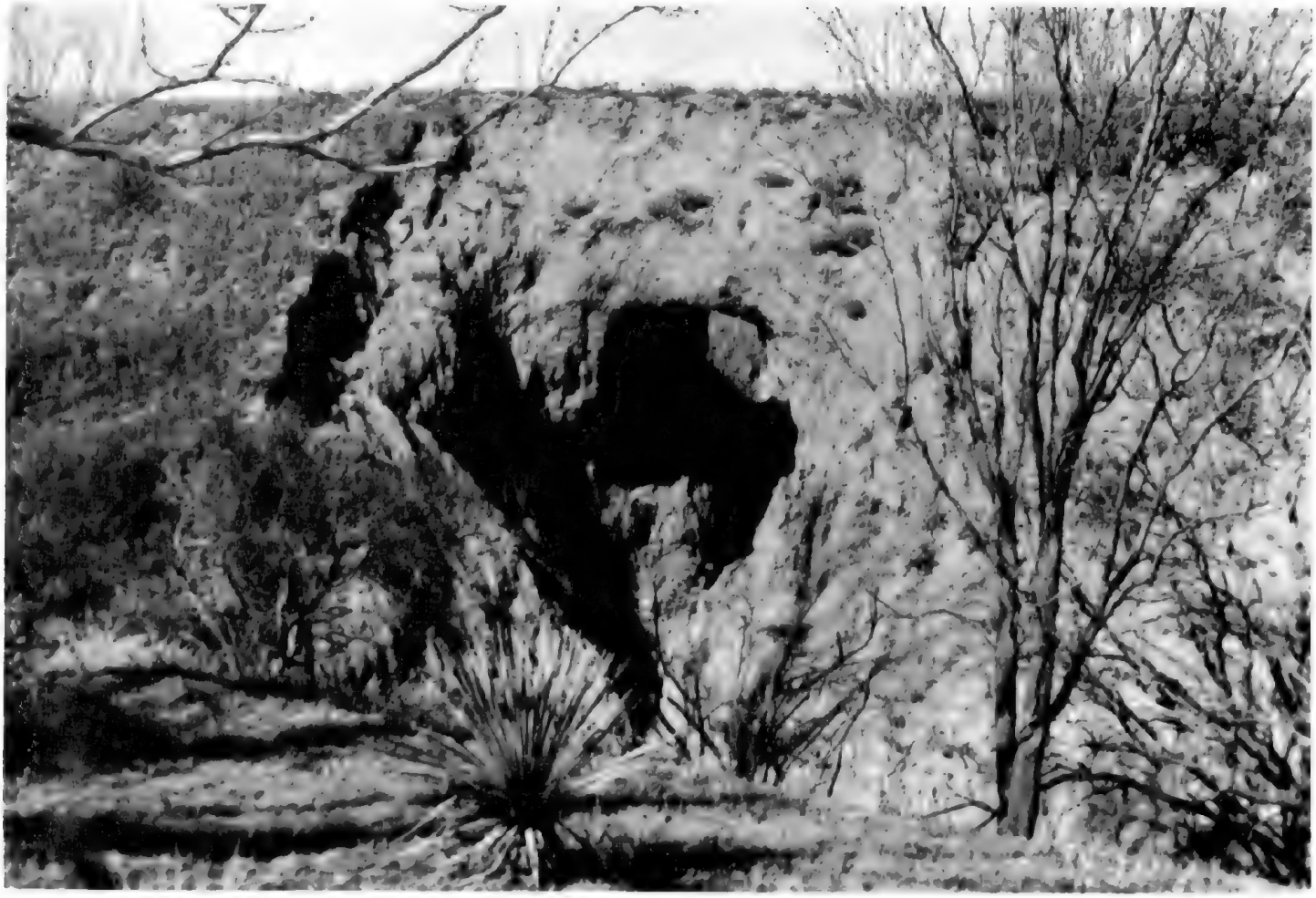


Figure 13.—Piping hazard on Woodward soils.

A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture (*4*). These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105° C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water (*5*). Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops.

They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 17, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a

seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

engineering index test data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and their morphology." The soil samples were tested by Texas State Department of Highways and Public Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Specific gravity (Particle density)—T 100 (AASHTO), D 653 (ASTM); Shrinkage—T 92 (AASHTO), D 427 (ASTM).

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*6*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 20, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustalf (*Ust*, meaning burnt, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplustalfs (*Hapl*, meaning minimal horizonation, plus *ustalf*, the suborder of the Alfisols that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplustalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, thermic Typic Haplustalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*4*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*6*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Acme series

The Acme series consists of shallow, loamy soils on uplands. These soils are gently sloping and well drained. They formed in materials weathered from impure gypsum. Slope ranges from 1 to 5 percent.

Typical pedon of Acme loam in an area of Acme-Cottonwood complex, 1 to 5 percent slopes; from the intersection of Interstate Highway 20 and Texas Highway 70 in Sweetwater, 8 miles east on Interstate Highway 20, 2 miles south on a gravel road, and 200 feet west in rangeland:

A11—0 to 10 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 3/4) moist; weak fine subangular blocky and granular structure; hard, friable; many

fine roots; many fine pores; calcareous; moderately alkaline; clear smooth boundary.
A12—10 to 18 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 3/4) moist; moderate fine subangular blocky and granular structure; hard, friable; many fine roots; many fine pores; calcareous; moderately alkaline; abrupt wavy boundary.
Cr—18 to 30 inches; white gypsum, containing reddish brown loam in crevices; massive; hard, weakly cemented; calcareous; moderately alkaline.

The solum is 10 to 20 inches thick.

The Cr horizon is weakly to strongly cemented gypsum.

The Acme soils in this survey area are taxadjuncts to the Acme series. These soils are a lighter color than is typical for the series, but this difference has not affected the use, management, and behavior of the soils.

Burson series

The Burson series consists of very shallow and shallow, loamy soils on uplands. These soils are rolling to hilly and well to excessively drained. They formed in silty and sandy Permian red beds. Slope ranges from 5 to 25 percent.

Typical pedon of Burson loam, in an area of Burson-Quinlan association, hilly; from the intersection of Interstate Highway 20 and U.S. Highway 70 east of Sweetwater, 7.5 miles east on Interstate Highway 20, 0.25 mile north in rangeland:

A1—0 to 7 inches; red (2.5YR 5/6) loam, red (2.5YR 4/6) moist; weak fine granular structure; slightly hard, friable, slightly sticky and plastic; about 20 percent by volume limestone fragments and siliceous pebbles; calcareous; moderately alkaline; clear smooth boundary.
Cr—7 to 36 inches; red (2.5YR 5/6) weakly cemented sandstone interbedded with silty and sandy materials; few soft masses of calcium carbonate and gypsum; few roots in the upper part; calcareous; moderately alkaline.

The solum is 3 to 12 inches thick.

The A horizon is red, reddish brown, or yellowish red. Coarse fragments range from 0 to 20 percent, by volume. The C horizon is red, reddish brown, and yellowish red weakly cemented sandstone stratified with grayish brown. Some pedons contain varying amounts of gypsum in the form of soft deposits and concretions.

The Burson soils in this survey area are taxadjuncts to the Burson series because they have more gravel than is typical for the series. This difference does not affect the use and management of the soil.

Cobb series

The Cobb series consists of moderately deep, loamy soils on uplands. These soils are nearly level to gently sloping and well drained. They formed in material derived from thick, medium grained, Permian sandstone. Slope ranges from 0 to 5 percent.

Typical pedon of Cobb fine sandy loam, 1 to 5 percent slopes; from the intersection of Farm Road 2319 and Farm Road 1230 in Champion, 2.0 miles east on Farm Road 2319, 2.0 miles south on a gravel road, and 300 feet southeast in cropland:

Ap—0 to 7 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; structureless; slightly hard, very friable; few fine roots; neutral; abrupt smooth boundary.
B21t—7 to 16 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and plastic; few fine roots; few fine pores; neutral; gradual smooth boundary.
B22t—16 to 38 inches; red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and plastic; moderately alkaline; abrupt wavy boundary.
Cr—38 to 42 inches or more; red, weakly cemented sandstone with thin coatings of calcium carbonate in crevices.

The solum is 20 to 40 inches thick. Reaction is slightly acid to neutral in the A horizon and slightly acid to moderately alkaline in the Bt horizon.

The A horizon is 6 to 10 inches thick. It is brown, light brown, or reddish brown. The B2t horizon is clay loam or sandy clay loam. The clay content is 22 to 35 percent. The B2 horizon is red or reddish brown. The Cr horizon is red or reddish brown, weakly to strongly cemented sandstone. A few pedons have soft masses of calcium carbonate.

Colorado series

The Colorado series consists of deep, loamy soils on bottom lands. These soils are nearly level and well drained. They formed in calcareous loamy alluvium. Slope ranges from 0 to 1 percent.

Typical pedon of Colorado loam, frequently flooded; from the intersection of Texas Loop 432 and Farm Road 419 in Sweetwater, 3.4 miles north on Farm Road 419 to railroad, 0.4 mile east on a gravel road, and 50 feet south in rangeland:

A1—0 to 8 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; moderate fine granular structure; slightly hard, very friable; common fine roots; many medium pores;

calcareous; moderately alkaline; abrupt smooth boundary.
C1—8 to 22 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; massive; slightly hard, very friable; few strata of reddish brown fine sandy loam about one-half inch thick; calcareous; moderately alkaline; gradual smooth boundary.
C2—22 to 64 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; massive; slightly hard, very friable; few strata of fine sandy loam and silty clay loam about 3 inches thick; calcareous; moderately alkaline.

The texture of the 10- to 40-inch control section is 18 to 35 percent clay and more than 15 percent material coarser than very fine sand.

The A horizon is 4 to 10 inches thick. It is light reddish brown, reddish brown, or brown. The C horizon is light reddish brown, reddish brown, or reddish yellow. Texture is silt loam or loam with strata of clay loam, fine sandy loam, silty clay loam, and loamy fine sand.

Cosh series

The Cosh series consists of shallow, loamy soils on uplands. These soils are gently sloping and well drained. They formed in medium grained sandstone. Slope ranges from 1 to 5 percent.

Typical pedon of Cosh fine sandy loam, 1 to 5 percent slopes; from Champion, 1.0 mile north on Farm Road 1230, 1.35 miles east on a gravel road, and 50 feet south in cropland:

Ap—0 to 5 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; many fine roots; common siliceous gravel on surface; neutral; abrupt smooth boundary.
B2t—5 to 14 inches; red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) moist; moderate medium subangular blocky structure; hard, firm to friable; thin patchy clay films on peds; few fine pores; neutral; abrupt smooth boundary.
Cr—14 to 24 inches; red (2.5YR 5/6) weakly cemented sandstone.

The solum is 12 to 20 inches thick. Reaction is slightly acid to neutral throughout.

The A horizon is 4 to 10 inches thick. It is reddish brown or brown. The B2t horizon is 6 to 14 inches thick. The clay content of the B2t horizon ranges from 18 to 35 percent. The Cr horizon is weakly to strongly cemented sandstone with a hardness of less than 3 on the Mohs scale.

Cottonwood series

The Cottonwood series consists of very shallow, loamy soils on uplands. These soils are gently sloping and well drained. They formed in materials weathered from impure gypsum. Slope ranges from 1 to 5 percent.

Typical pedon of Cottonwood loam, in an area of Acme-Cottonwood complex, 1 to 5 percent slopes; from the intersection of Interstate Highway 20 and Texas Highway 70 in Sweetwater, 8 miles east on Interstate Highway 20, 2 miles south on a gravel road, and 100 feet west in rangeland:

A1—0 to 8 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky and granular structure; slightly hard, friable, slightly sticky; common fine roots; few fine pores; calcareous; moderately alkaline; abrupt smooth boundary.
Cr1—8 to 16 inches; light reddish brown (5YR 6/3) loam, reddish brown (5YR 5/3) moist; massive; 60 percent by volume soft masses of gypsum; calcareous; moderately alkaline; abrupt smooth boundary.
Cr2—16 to 22 inches; white (10YR 8.2) soft chalky gypsum that becomes harder with depth; calcareous; moderately alkaline.

The A horizon is brown, light brown, or light reddish brown. The Cr horizon is weakly to strongly cemented chalky gypsum. Gypsum content ranges from 50 to 90 percent, by volume.

Ector series

The Ector series consists of very shallow and shallow, undulating to hilly, loamy soils on uplands. They formed in material derived from limestone. Slope ranges from 1 to 20 percent.

Typical pedon of Ector very gravelly clay loam, 1 to 8 percent slopes; from the school at Nolan, 7 miles east on Farm Road 126 to Taylor County line, 1.25 miles south on a gravel road, and 100 feet west in rangeland:

A11—0 to 6 inches; dark brown (7.5YR 4/2) very gravelly clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky and granular structure; hard, friable, slightly sticky and plastic; about 33 percent by volume limestone gravel, 7 percent cobbles, and 5 percent stones; about 50 percent of the surface is also covered with limestone fragments; calcareous; moderately alkaline; abrupt smooth boundary.
A12ca—6 to 12 inches; dark brown (7.5YR 4/2) very gravelly clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky and granular structure; hard, friable, slightly sticky and plastic; about 60 percent by volume gravel-size limestone fragments; fragments are coated with calcium carbonate on the lower sides; calcareous; moderately alkaline; abrupt smooth boundary.
R&Cca—12 to 16 inches; hard fractured limestone with hardness of more than 3 on Mohs scale; calcium

carbonate in crevices and as undercoatings on limestone fragments; cracks filled with dark loamy earth.
R—16 to 18 inches; fractured limestone bedrock coated with calcium carbonate in crevices in the upper part.

The solum ranges from 4 to 20 inches in thickness and is 35 to 70 percent limestone fragments. The fragments are about 60 to 75 percent gravel-size, 15 to 25 percent cobble-size, and 0 to 20 percent stone-size.

The A horizon is dark grayish brown, dark brown, or brown. The R horizon is fractured hard limestone or interbedded fractured limestone and marl.

Gageby series

The Gageby series consists of deep, loamy soils on bottom lands. These soils are nearly level to gently sloping and well drained. They formed in calcareous alluvium. Slope ranges from 0 to 2 percent.

Typical pedon of Gageby clay loam, occasionally flooded; from Champion, 1.0 mile east on Farm Road 2319, 1.0 mile south on a gravel road, and 200 feet west in a pasture:

A11—0 to 12 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm to friable, sticky and plastic; common wormcasts; many fine roots; calcareous; moderately alkaline; gradual smooth boundary.
A12—12 to 31 inches; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm to friable, sticky and plastic; many fine roots; common fine pores; calcareous; moderately alkaline; gradual smooth boundary.
B2—31 to 44 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm to friable, sticky and plastic; few threads of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.
IIC1ca—44 to 64 inches; yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; hard, very friable; few threads and films of calcium carbonate; 20 percent by volume rounded gravel; calcareous; moderately alkaline.

The solum is 28 to 50 inches thick. The clay content of the 10- to 40-inch control section is from 25 to 35 percent, and more than 15 percent is material coarser than very fine sand. Reaction is moderately alkaline throughout.

The A horizon is 20 to 36 inches thick. It is dark grayish brown, dark brown, or brown. The B horizon is 8 to 15 inches thick. It is brown, dark grayish brown, or yellowish brown. The IIC horizon has textures of loam or fine sandy loam that is pale brown, yellowish brown, or light yellowish brown. Thin strata of fine sand and loamy fine sand occur in some pedons.

The Gageby soils in this survey area are taxadjuncts to the Gageby series. They have more silt and less medium and coarse sand than is typical for the series. This difference has not affected the use and management of the soils.

Kavett series

The Kavett series consists of shallow, clayey soils on uplands. These soils are nearly level to gently sloping and well drained. They formed in materials weathered from limestone. Slope ranges from 0 to 3 percent.

Typical pedon of Kavett clay, 1 to 3 percent slopes; from the school in Nolan, 7 miles east on Farm Road 126 to the county line, 2.25 miles south on a gravel road to its intersection with another gravel road, continue 1.1 miles south, and 100 feet east in rangeland:

A11—0 to 7 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; very hard, very firm, sticky and plastic; many fine roots; few limestone cobbles on the surface; cracks 1/2 inch to 2 inches wide; calcareous; moderately alkaline; clear smooth boundary.
A12—7 to 16 inches; brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; very hard, very firm, sticky and plastic; many fine roots; few calcium carbonate concretions; calcareous; moderately alkaline; abrupt smooth boundary.
Ccam—16 to 19 inches; white (10YR 8/1) hard caliche plates, 4 to 12 inches across the long axis and 1/2 to 1 inch thick; brown (10YR 5/3) silty clay between plates.
R—19 to 24 inches; fractured indurated limestone; carbonates on faces of fractures.

The solum is 10 to 20 inches thick. The cobble-size fragments of limestone range from 0 to 10 percent, by volume.

The A horizon is very dark grayish brown, dark grayish brown, or dark brown. The Ccam horizon is strongly cemented to indurated carbonates in the form of plates and laminar caps on indurated limestone. The R horizon is indurated limestone or interbedded limestone and marl.

Knoco series

The Knoco series consists of very shallow, clayey soils on uplands. These soils are gently sloping to sloping and well to excessively drained. They formed in red-bed clays. Slope ranges from 1 to 8 percent.

Typical pedon of Knoco clay, 1 to 8 percent slope; from the intersection of Interstate Highway 20 and Texas

Loop 432 east of Sweetwater, 6 miles east on Interstate Highway 20, and 0.5 mile northeast in rangeland:

A1—0 to 8 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; moderate medium blocky structure; very hard, very firm, very sticky and plastic; common fine roots; calcareous; moderately alkaline; clear smooth boundary.
Cr—8 to 30 inches; red (2.5YR 5/6) clayey shale, red (2.5YR 4/6) moist; massive; very hard, very firm, very sticky and plastic; thin grayish brown strata; calcareous; moderately alkaline.

The solum is from 3 to 12 inches thick.

The A horizon is red or reddish brown. Some areas have 10 to 20 percent of the surface covered by quartz or sandstone fragments that are mostly gravel-size. The Cr horizon is red shaly clay or clayey shale stratified with weakly cemented sandstone in places. Many pedons contain strata of grayish brown shaly clay. Gypsum in the form of soft masses and weakly cemented strata is in some pedons.

Latom series

The Latom series consists of very shallow and shallow, loamy soils on uplands. These soils are rolling and well drained. They formed in materials weathered from sandstone. Slope ranges from 2 to 5 percent on ridgetops and 5 to 20 percent on side slopes.

Typical pedon of Latom fine sandy loam, in an area of Latom-Rock outcrop association, rolling; from the intersection of Farm Road 2319 and Farm Road 1230 at Champion, 1.25 miles east on Farm Road 2319, and 400 feet south in rangeland:

A1—0 to 5 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; about 10 percent of surface covered with sandstone boulders; calcareous; moderately alkaline; abrupt smooth boundary.
R—5 to 12 inches; reddish gray (5YR 5/2) strongly cemented sandstone bedrock.

The solum is 4 to 14 inches thick.

The A horizon is reddish brown or brown. The R horizon is strongly cemented sandstone or conglomerate with a hardness of 3 to 4 on the Mohs scale.

Lozier series

The Lozier series consists of very shallow, loamy soils on uplands. These soils are steep and well drained. They formed in loamy materials weathered from limestone bedrock. Slope ranges from 20 to 40 percent.

Typical pedon of Lozier very gravelly loam in an area of Lozier-Rock outcrop association, steep; from the intersection of Texas Highway 70 and Interstate Highway 20 in Sweetwater, 5 miles south on Texas Highway 70; 1.0 mile east on private road to a ranch headquarters, and 0.6 mile east-northeast in rangeland:

A1—0 to 5 inches; light brownish gray (10YR 6/2) very gravelly loam, grayish brown (10YR 5/2) moist; weak medium subangular blocky structure; slightly hard, friable; many fine roots; about 30 percent by volume gravel-size and 10 percent cobble-size limestone fragments; calcareous; moderately alkaline; abrupt smooth boundary.
R&Cca—5 to 12 inches; fractured platy limestone; caliche coatings on the surface; fractures and crevices are filled with calcium carbonate; abrupt smooth boundary.
R—12 to 20 inches; fractured limestone bedrock with thin coatings of calcium carbonate in seams in the upper part.

The solum is 4 to 16 inches thick and is 35 to 80 percent coarse fragments. The fragments are about 70 to 80 percent gravel-size and 20 to 30 percent cobble-size. The solum is light brown, pale brown, or light brownish gray. Caliche coatings on the limestone fragments range from faint films to coatings that are about 1 inch thick. On limestone bedrock the coatings are 1/4 to 1 inch thick.

Mereta series

The Mereta series consists of shallow to caliche, loamy soils on uplands. These soils are nearly level to gently sloping and well drained. They formed in calcareous loamy outwash. Slope ranges from 0 to 3 percent.

Typical pedon of Mereta clay loam, 1 to 3 percent slopes; from the intersection of Interstate Highway 20 and Farm Road 608 in Roscoe, 6 miles west, 1.2 miles north on a gravel road, and 100 feet east in cropland:

Ap—0 to 8 inches, brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; weak fine granular structure; hard, friable, slightly sticky and plastic; many fine roots; few fine pores; calcareous; moderately alkaline; abrupt smooth boundary.
A1—8 to 18 inches, brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate fine granular structure; hard, friable, slightly sticky and plastic; many fine roots; calcareous; moderately alkaline; abrupt smooth boundary.
C1cam—18 to 22 inches; pink (7.5YR 8.4) caliche, pink (7.5YR 7/4) moist; strongly cemented and platy; caliche plates about 1 inch thick and 5 inches across with fine earth between plates; clear wavy boundary.
C2ca—22 to 40 inches; pink (5YR 8/3) loam, pink (5YR 7/3) moist; massive; hard, friable; about 80 percent by volume soft masses of calcium carbonate.

The solum is 14 to 20 inches thick.

The A horizon is dark grayish brown or brown. It is 0 to 10 percent, by volume, limestone fragments 3 inches or less in diameter. The Ccam horizon is 4 to 8 inches thick and has a hardness of 2 to 3 on the Mohs scale. Plates are 0.5 inch to 2 inches thick and 5 to 8 inches across the long axis. The C2ca horizon is soft limy earth of loam or fine sandy loam that is 50 to 80 percent carbonates. Strata of indurated limestone gravel and caliche are at varying depths.

Miles series

The Miles series consists of deep soils on uplands. These soils are nearly level to gently sloping and well drained. They formed in loamy and sandy sediments. Slope ranges from 0 to 5 percent.

Typical pedon of Miles fine sandy loam, 1 to 3 percent slopes; from Hylton, 0.5 mile west on Farm Road 1170, 1.5 miles north on a gravel road, 0.5 mile west, 0.3 mile south on a field road in rangeland:

A1—0 to 10 inches, reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine granular and subangular blocky structure; slightly hard, very friable; many fine roots; few quartz pebbles; neutral; abrupt smooth boundary.

B21t—10 to 18 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; hard, friable; many fine roots; few fine pores; few very fine quartz pebbles; neutral; clear smooth boundary.

B22t—18 to 36 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 3/6) moist; weak medium subangular blocky structure; hard, friable; thin patchy clay films on peds; few fine roots; few rounded quartz pebbles; mildly alkaline; clear smooth boundary.

B23t—36 to 52 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; hard, friable; few patchy clay films on peds; few quartz pebbles; mildly alkaline; abrupt smooth boundary.

B3ca—52 to 63 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; hard, friable; few quartz pebbles; about 10 percent by volume soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—63 to 80 inches; red (2.5YR 5/6) fine sandy loam, red (2.5YR 4/6) moist; massive; slightly hard, very friable; calcareous; moderately alkaline.

The solum is 60 to 80 inches or more thick. Depth to secondary lime is 36 to 60 inches. There is a calcic horizon below a depth of 50 inches in some pedons. Reaction is slightly acid to neutral in the A and B21t horizons, and neutral to moderately alkaline in the lower B2t horizon.

The A horizon is 7 to 20 inches thick. It is brown, pale brown, light reddish brown, or reddish brown. Texture is fine sandy loam or loamy fine sand. The B2t horizon is reddish brown, red, or yellowish red. Texture is sandy clay loam, loam, or clay loam. The C horizon ranges in texture from loamy fine sand to fine sandy loam. It is red or reddish yellow.

These soils are taxadjuncts to the Miles series. They differ from Miles soils elsewhere because they have a calcic horizon at a depth of 60 inches or less and free carbonates occur in nearly all pedons below a depth of 40 inches. These differences, however, do not affect the use, management, or behavior of the soils.

Nipsum series

The Nipsum series consists of deep, clayey soils on uplands. These soils are nearly level to gently sloping and well drained. They formed in clayey alluvium or colluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Nipsum clay loam, 1 to 3 percent slopes; from the Nolan and Taylor county line, 5.25 miles west on Interstate Highway 20, 3.25 miles south on Adrian Road, and 500 feet southwest in rangeland:

A11—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm to friable, sticky and plastic; calcareous; moderately alkaline; clear smooth boundary.

A12—8 to 28 inches, dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium to coarse subangular blocky structure; very hard, very firm, very sticky and plastic; calcareous; moderately alkaline; clear smooth boundary.

Bca—28 to 48 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate medium to coarse subangular blocky structure; very hard, very firm, very sticky and plastic; about 3 percent by volume soft masses of calcium carbonate; calcareous; moderately alkaline.

C—48 to 60 inches, reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; massive; hard, friable, sticky and plastic; about 3 percent by volume calcium carbonate in the form of concretions, films, threads, and soft masses; calcareous; moderately alkaline.

The solum is 40 to 60 inches or more thick. Thickness of the mollic epipedon is 20 to 40 inches. Depth to the calcic horizon is 40 inches or more. The clay content of the 10- to 40-inch control section ranges from 35 to 45 percent.

The A horizon is 20 to 40 inches thick. It is dark grayish brown, dark brown, and reddish brown. The A12

horizon is clay loam, clay, or silty clay. The Bca horizon is silty clay, clay, or clay loam. It is brown or reddish brown. It is 20 to 30 inches thick. The C horizon is reddish brown. Texture is clay, silty clay, or clay loam. Soft masses and concretions of visible carbonates range from 0 to 10 percent, by volume.

Paducah series

The Paducah series consists of deep, loamy soils on uplands. These soils are gently sloping and well drained. They formed in silty red-bed materials. Slope ranges from 1 to 5 percent.

Typical pedon of Paducah loam, 1 to 3 percent slopes; from the intersection of Interstate Highway 20 and Texas Highway 70 on the south side of Sweetwater, 1 mile west on Interstate Highway 20, 0.4 mile north on a paved road, and 200 feet west in cropland:

Ap—0 to 7 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; mildly alkaline; abrupt smooth boundary.

B21t—7 to 18 inches, reddish brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate fine subangular blocky and granular structure; slightly hard, friable; common fine pores; mildly alkaline; abrupt smooth boundary.

B22t—18 to 42 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky and granular structure; slightly hard, friable; mildly alkaline; gradual smooth boundary.

B3—42 to 48 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) weak granular structure; slightly hard, very friable; moderately alkaline; clear smooth boundary.

Cca—48 to 54 inches, reddish yellow (5YR 6/6) loam, yellowish red (5YR 5/6) moist; massive; weakly cemented sandstone; 10 percent by volume soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Cr—54 to 68 inches; light reddish brown (5YR 6/4) weakly cemented loamy red beds; massive; calcareous; moderately alkaline.

The solum is 36 to 72 inches or more thick. Carbonates occur at a depth of 16 to 48 inches or more. The clay content of the Bt horizon is 18 to 35 percent.

The A horizon is 6 to 14 inches thick. It is reddish brown or brown. The B2t horizon is silty clay loam or silt loam. It is red, reddish brown, or yellowish red. The B3 and C horizons are red, light reddish brown, reddish yellow, or yellowish red. The Cca horizon contains from 5 to 15 percent calcium carbonate. The Cr horizon is weakly to strongly cemented sandstone.

The Paducah soils in this survey area are taxadjuncts to the Paducah series because they are leached of carbonates to a slightly greater depth than is typical for the series. This difference has not affected the use and management of the soils.

Pitzer series

The Pitzer series consists of shallow to very shallow, loamy soils on uplands. These soils are gently sloping to sloping and well drained. They formed in ancient gravelly alluvium. Slope ranges from 1 to 8 percent.

Typical pedon of Pitzer gravelly loam, 1 to 8 percent slopes; from the Nolan and Taylor county line, 2 miles west on Interstate Highway 20 on the south service road, 0.75 mile south on a private gravel road, and 0.5 mile southwest on an oil field road near a gravel pit:

A1—0 to 6 inches; dark brown (7.5YR 4/2) gravelly loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; slightly hard, friable; about 25 percent by volume rounded caliche gravel; calcareous; moderately alkaline; abrupt smooth boundary.

C1cam—6 to 12 inches; white (10YR 8/2) indurated caliche; fractured plates 3 to 6 inches across the long axis and 1 to 3 inches thick; hardness of about 3 on the Mohs scale; common limestone and siliceous gravel embedded in caliche; abrupt smooth boundary.

C2ca—12 to 54 inches; reddish yellow (7.5YR 7/6) extremely gravelly sandy loam, reddish yellow (7.5YR 6/6) moist; about 70 percent by volume limestone and siliceous gravel; common strongly cemented boulders with gravel embedded in the matrix.

The solum is 4 to 14 inches thick. It is underlain by a petrocalcic horizon of indurated platy caliche.

The A horizon is brown or dark brown. Coarse fragments of limestone and siliceous gravel range from 0 to 25 percent, by volume. The Ccam horizon is 5 to 12 inches thick. It is platy in the upper part and massive in the lower part. It has a hardness of 3 or more on the Mohs scale. The C2ca horizon contains 30 to 70 percent limestone and siliceous gravel. The fine earth fraction is loam or sandy loam texture. This horizon is mostly weakly consolidated, but some pedons have boulder-size, indurated caliche fragments at varying depths.

Potter series

The Potter series consists of very shallow soils on uplands. These soils are gently sloping to moderately steep and well drained. They formed in thick beds of caliche. Slope ranges from 1 to 20 percent.

Typical pedon of Potter gravelly loam, 1 to 20 percent slopes; from the junction of Texas Loop 432 and Texas Highway 70 in Sweetwater, 2 miles west, 1.6 miles north, and 0.75 mile west on a gravel road, and 100 feet south in rangeland:

A1—0 to 5 inches; grayish brown (10YR 5/2) gravelly loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; many fine roots; about 5 percent by volume concretions of calcium carbonate; few fragments of hard caliche less than 1/4 inch in diameter; 40 percent surface cover of siliceous pebbles; calcareous; moderately alkaline; abrupt smooth boundary.

C1ca—5 to 12 inches; white (10YR 8/2) platy caliche with a hardness of about 2 on the Mohs scale; plates are fractured with pendants of calcium carbonate on the lower sides of plates; light brownish gray (10YR 6/2) loam between cracks and in crevices; few roots between crevices; calcareous; moderately alkaline; clear smooth boundary.

C2ca—12 to 80 inches; white (10YR 8/2) limy earth; carbonates comprise 70 percent, by volume; massive; hard, friable; calcareous; moderately alkaline.

The A1 horizon is 4 to 12 inches thick and contains up to 35 percent coarse fragments. It is brown, light brown, pale brown, or grayish brown. The C1ca horizon is 4 to 12 inches thick. Hardness ranges from weak to strongly cemented. Color ranges from white to yellowish brown. The C2ca horizon consists of weakly cemented caliche that ranges from white to yellowish brown. The carbonate content ranges from 40 to 70 percent, by volume.

The Potter soils in the survey area are taxadjuncts to the Potter series because they have slightly more sand and less clay than is typical for the series. This difference has not affected the use and management of the soils.

Quinlan series

The Quinlan series consists of shallow, loamy soils on uplands. These soils are gently sloping to rolling and well drained. They formed in calcareous, red-bed sandstone. Slope ranges from 1 to 16 percent.

Typical pedon of Quinlan loam, 1 to 5 percent slopes; from the intersection of Interstate Highway 20 and Farm Road 1856, 4 miles south on Farm Road 1856, 1.0 mile east, 0.25 mile south on graveled road, and 200 feet east in a field:

A1—0 to 6 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; slightly hard, very friable; common fine roots; calcareous; moderately alkaline; abrupt smooth boundary.

B2—6 to 13 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; common fine roots; calcareous; moderately alkaline; abrupt smooth boundary.

Cr—13 to 44 inches; yellowish red (5YR 5/6) weakly cemented, calcareous sandstone with thin seams of grayish brown and yellowish brown fine sandy loam and sandy clay loam.

The solum is 10 to 20 inches thick. It is moderately alkaline throughout.

The A horizon is 4 to 10 inches thick. It is reddish brown, light brown, light reddish brown, or brown. The B2 horizon is loam or very fine sandy loam. It is from 4 to 7 inches thick. It is reddish brown, light reddish brown, or yellowish red. The Cr horizon is sandstone with varying degrees of hardness. It ranges from packed sand to weakly cemented sandstone. Some pedons contain a few soft masses of calcium carbonate and gypsum.

Randall series

The Randall series consists of deep, clayey soils that formed in playas. These soils are nearly level and somewhat poorly drained. Slope ranges from 0 to 1 percent.

Typical pedon of Randall clay; from the Nolan and Taylor county line, 0.75 mile west on Farm Road 126 and 100 feet south in rangeland:

A11—0 to 6 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine and medium subangular blocky structure; extremely hard, very firm, very sticky and plastic; surface mulch of very fine hard granules; cracks 1 to 3 inches wide extend from the surface downward; noncalcareous; moderately alkaline; clear wavy boundary.

A12—6 to 22 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate coarse blocky structure; extremely hard, very firm, very sticky and plastic; noncalcareous; moderately alkaline; clear wavy boundary.

AC1—22 to 53 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate coarse blocky structure; extremely hard, very firm, very sticky and plastic; few fine faint brownish mottles; few very fine iron-manganese concretions; common prominent intersecting slickensides; noncalcareous; moderately alkaline; clear smooth boundary.

AC2—53 to 80 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; few faint brownish mottles; weak coarse blocky structure; extremely hard, very firm, very sticky and plastic; few very fine concretions of calcium carbonate; few very fine iron-manganese concretions; calcareous; moderately alkaline.

The solum is 40 to 80 inches or more thick. Virgin areas have gilgai microrelief. Surface cracks 1 to 3 inches wide extend to a depth of more than 20 inches when the soil is dry. Reaction is neutral to moderately alkaline in the A horizon.

The A horizon is 10 to 25 inches thick. It is gray, dark gray, or very dark gray. The AC horizon is gray or grayish brown. In places it contains brownish mottles and iron-manganese concretions. Some pedons have soft masses and concretions of calcium carbonate in the lower part.

Roscoe series

The Roscoe series consists of deep, clayey soils on uplands. These soils are nearly level and moderately well drained. They formed in alkaline clays. Slope ranges from 0 to 1 percent.

Typical pedon of Roscoe clay; from the intersection of Interstate Highway 20 and U.S. Highway 84 about 5 miles west of Sweetwater, 1.1 miles west on Interstate Highway 20, 0.5 mile north on a gravel road, and 200 feet west in cropland:

Ap—0 to 7 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine angular blocky structure; very hard, firm, sticky and plastic; surface mulch of very hard fine granules; few fine roots; mildly alkaline; abrupt smooth boundary.

A11—7 to 14 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine angular blocky structure; very hard, firm, sticky and plastic; shiny pressure faces on peds; few fine roots; mildly alkaline; diffuse wavy boundary.

A12—14 to 30 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate medium angular blocky structure; extremely hard, very firm, very sticky and plastic; contains parallelepipeds that have the long axis tilted about 30 degrees from horizontal; few intersecting slickensides in lower part; shiny pressure faces on peds; noncalcareous in upper part; calcareous with few very fine calcium carbonate concretions in lower part; mildly alkaline in upper part, moderately alkaline in lower part; gradual wavy boundary.

AC—30 to 45 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; common medium to very fine pockets of light brown (7.5YR 6/4) C horizon material; moderate medium blocky structure; extremely hard, very firm, very sticky and plastic; contains parallelepipeds that have the long axis tilted about 30 degrees from horizontal; distinct intersecting grooved slickensides; shiny pressure faces on peds; few very fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

C1ca—45 to 60 inches; light brown (7.5YR 6/4) clay, brown (7.5YR 4/4) moist; common vertically oriented streaks of grayish brown (10YR 5/2) material; massive; very hard, firm; about 10 percent by volume concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C2—60 to 75 inches; light brown (7.5YR 6/4) clay, brown (7.5YR 5/4) moist; massive; very hard, firm; few concretions and soft masses of calcium carbonate decreasing with depth; calcareous; moderately alkaline.

The soil is 6 to 10 feet or more thick over rock or loamy material. Uncultivated areas have gilgai microrelief in which knolls are 3 to 8 inches higher than depressions. The center of knolls and the center of depressions are from 7 to 12 feet apart. Intersecting slickensides and wedge-shaped parallelepipeds begin 20 to 30 inches below the surface. The 10- to 40-inch control section is 40 to 60 percent clay that is dominantly montmorillonite. The A horizon is 18 inches thick on microknolls to 44 inches thick in microdepressions. It is gray, dark gray, grayish brown, or very dark gray. Reaction ranges from neutral to moderately alkaline and calcareous. The AC horizon is dark gray, grayish brown, or dark grayish brown. It is 10 to 20 inches thick. The C horizon is light brown, white, or very pale brown. Visible segregated carbonates in the Cca horizon is 1 to 30 percent.

Rotan series

The Rotan series consists of deep, loamy soils on uplands. These soils are nearly level to gently sloping and well drained. They formed in calcareous, loamy outwash. Slope ranges from 0 to 3 percent.

Typical pedon of Rotan clay loam, 0 to 1 percent slopes; from the Nolan and Taylor county line, 2 miles west on Interstate Highway 20, 1.25 miles north on a county road to an intersection, 50 feet east, and 300 feet south of county road in cropland:

Ap—0 to 9 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and plastic; noncalcareous; moderately alkaline; abrupt smooth boundary.

B1—9 to 15 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; very hard, friable, sticky and plastic; noncalcareous; moderately alkaline; abrupt smooth boundary.

B21t—15 to 24 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; noncalcareous; moderately alkaline; clear smooth boundary.

B22t—24 to 36 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate medium blocky structure; very hard, very firm, very sticky and plastic; calcareous; moderately alkaline; gradual smooth boundary.

B23t—36 to 50 inches; dark brown (7.5YR 4/4) clay, dark brown (7.5YR 3/4) moist; moderate medium

blocky structure; very hard, very firm, sticky and plastic; calcareous; moderately alkaline; clear smooth boundary.

B24tca—50 to 66 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; very hard, firm, sticky and plastic; about 20 percent soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum is 60 inches or more thick. Secondary carbonates are within 10 to 28 inches of the surface. Depth to a calcic horizon is 30 to 60 inches. The mollic epipedon is 20 to 40 inches or more thick.

The A horizon is 4 to 12 inches thick. It is brown, grayish brown, dark brown, or dark grayish brown. It is mildly alkaline or moderately alkaline. The B1 horizon is brown, grayish brown, or dark grayish brown. It is 4 to 14 inches thick. Texture is silty clay loam or clay loam. The B2t horizon is clay loam or clay. It is reddish brown, grayish brown, brown, or dark grayish brown. The Btca horizon is reddish yellow or yellowish red. It contains 15 to 50 percent soft masses and concretions of calcium carbonate, by volume.

Rowena series

The Rowena series consists of deep, loamy soils on uplands. These soils are nearly level to gently sloping and well drained. They formed in calcareous loamy outwash. Slope ranges from 0 to 3 percent.

Typical pedon of Rowena clay loam, 0 to 1 percent slopes; from the intersection of Interstate Highway 20 and Farm Road 608 in Roscoe, 6 miles west on Interstate Highway 20, 2.0 miles north, 0.5 mile east on a gravel road, and 200 feet south in cropland:

Ap—0 to 4 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; hard, friable, sticky and plastic; calcareous; moderately alkaline; abrupt smooth boundary.

A1—4 to 12 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm to friable, sticky and plastic; calcareous; moderately alkaline; clear smooth boundary.

B21—12 to 28 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; a few vertical streaks of dark brown clay loam extend to a depth of 25 inches in filled cracks; few concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B22—28 to 38 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; few fine soft masses of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

C1ca—38 to 55 inches; pink (7.5YR 7/4) clay loam, light brown (7.5YR 6/4) moist; massive; hard, friable, slightly sticky and plastic; about 40 percent by volume soft masses of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

C2ca—55 to 69 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; massive; hard, firm to friable, slightly sticky and plastic; about 25 percent by volume soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum is 22 to 48 inches thick. Secondary carbonates occur throughout the solum. The B2 horizon has COLE of 0.07 or more in some part. When dry these soils have cracks 1 centimeter or more wide in the upper subsoil. Depth to the calcic horizon is 20 to 40 inches below the surface.

The A horizon is 5 to 12 inches thick. It is dark brown, dark grayish brown, or very dark grayish brown.

The B2 horizon is 20 to 30 inches thick. It is dark brown or brown. Texture is clay loam to clay. Clay content is 35 to 50 percent. The Cca horizon is 8 to 30 inches or more thick. It is light brown, pale brown, reddish yellow, light yellowish brown, or pink. It is 20 to 60 percent soft masses and concretions of calcium carbonate.

Sagerton series

The Sagerton series consists of deep, loamy soils on uplands. These soils are nearly level to gently sloping and well drained. They formed in calcareous loamy outwash. Slope ranges from 0 to 3 percent.

Typical pedon of Sagerton clay loam, 0 to 1 percent slopes; from the Nolan and Taylor county line on Interstate Highway 20, 1 mile west, 1 mile north on White Flat Road, and 350 feet in cropland:

Ap—0 to 10 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular and subangular blocky structure; hard, friable, slightly sticky and plastic; mildly alkaline; abrupt smooth boundary.

B21t—10 to 19 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate fine subangular blocky structure; very hard, very firm, sticky and plastic; common worm casts; thin patchy clay films on ped faces; mildly alkaline; gradual smooth boundary.

B22t—19 to 25 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; few very fine pores; thin patchy clay films on ped faces; noncalcareous; moderately alkaline; clear boundary.

B23t—25 to 53 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; common very fine pores; thin patchy clay films on ped faces; few threads and films and fine concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.
B24tca—53 to 68 inches; light red (2.5YR 6/6) clay loam, red (2.5YR 5/6) moist; weak fine subangular blocky structure; hard, firm, sticky and plastic; few very fine pores; thin patchy clay films on ped faces; about 20 percent by volume soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum is 60 inches or more thick. Depth to secondary carbonates is 13 to 28 inches. Depth to a calcic horizon is 30 to 60 inches.

The A horizon is 5 to 12 inches thick. It is brown, dark brown, or reddish brown. Reaction is neutral or mildly alkaline. The Bt horizon is clay or clay loam with clay content of 35 to 45 percent. It is red, reddish brown, yellowish red, or reddish yellow. The B24tca horizon is red, light red, or yellowish red. It is clay loam or silty clay loam. Calcium carbonate content is 15 to 40 percent by volume.

The engineering data and the field notes indicate that the reduction in clay is more than 20 percent from the maximum in the argillic horizon within 60 inches of the surface. The soils are closer to Sagerton soils than to those of any other series. They are considered taxadjuncts because of the clay reduction in the lower part of the Bt horizon. This has not affected the use and management of the soils.

Shep series

The Shep series consists of deep, loamy soils on uplands. These soils are gently sloping to strongly sloping and well drained. They formed in calcareous loamy alluvium and colluvial sediments. Slope ranges from 1 to 12 percent.

Typical pedon of Shep loam, 1 to 5 percent slopes; from the Nolan and Taylor county line on Interstate Highway 20, 5.5 miles west, 2.75 miles south on Adrian Road, 0.3 mile east, 0.3 mile south to a ranch house, and 0.75 mile south on a pasture road in rangeland:

A1—0 to 12 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; strong fine granular structure; hard, friable, slightly sticky and plastic; few fragments of broken limestone; calcareous; moderately alkaline; gradual smooth boundary.
B2—12 to 22 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; strong fine granular structure; slightly hard, friable, slightly sticky and plastic; few fragments of broken limestone; many fine roots; calcareous; moderately alkaline; gradual smooth boundary.
Cca—22 to 60 inches; reddish yellow (7.5YR 6/6) loam, strong brown (7.5YR 5/6) moist; massive; slightly hard, friable, slightly sticky and plastic; about 7 percent by volume calcium carbonate in the form of threads and soft masses; calcareous; moderately alkaline.

The solum is 22 to 40 inches thick over a calcic horizon.

The A horizon is 4 to 12 inches thick. It is brown, reddish brown, pale brown, or grayish brown. The B horizon is loam, clay loam, or sandy clay loam. It is brown, reddish brown, or light reddish brown. The Cca horizon is brown, pink, light reddish brown, or reddish yellow. It contains from 1 to 15 percent visible carbonates in the form of films, threads, soft masses, and concretions.

Spade series

The Spade series consists of moderately deep, loamy soils on uplands. These soils are gently sloping and well drained. They formed in sandstone. Slope ranges from 1 to 5 percent.

Typical pedon of Spade loam, 1 to 3 percent slopes; from Champion, 1 mile east on Farm Road 2319, 2.5 miles south on a gravel road, and 0.3 mile west in cropland:

Ap—0 to 6 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; calcareous; moderately alkaline; abrupt smooth boundary.
B21—6 to 21 inches, reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; moderate fine granular structure; slightly hard, very friable; many worm casts; few threads and films and few very fine calcium carbonate concretions; calcareous; moderately alkaline; abrupt smooth boundary.
B22ca—21 to 28 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; moderate fine granular structure; slightly hard, friable; few worm casts; few very fine roots; about 10 percent by volume fine and very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.
R—28 to 48 inches; light gray (10YR 7/2) weakly cemented and strongly cemented sandstone; massive; thin strata of yellowish brown sandstone; about 15 percent soft masses of calcium carbonate in cracks and seams.

The solum is 20 to 40 inches thick. Texture of the control section is fine sandy loam to loam with the clay content ranging from 10 to 18 percent.

The A horizon is 4 to 12 inches thick. It is brown, light brown, or pale brown. The B21 horizon is 12 to 30 inches thick. It is reddish brown, brown, or light brown. It

is a loam or fine sandy loam. Concretions of calcium carbonate range from 0 to 10 percent, by volume. The B22ca horizon is 6 to 8 inches thick. It is reddish brown, light reddish brown, brown, or light brown. Calcium carbonate in the form of soft masses and concretions is 3 to 30 percent of the volume. Texture is loam or fine sandy loam. The R horizon is weakly to strongly cemented sandstone. It ranges from yellowish brown to grayish brown. It contains about 15 percent or less calcium carbonate in the form of soft masses and concretions.

Speck series

The Speck series consists of shallow, clayey soils on uplands. These soils are nearly level to gently sloping and well drained. They formed in limestone bedrock. Slope ranges from 0 to 3 percent.

Typical pedon of Speck clay loam, 1 to 3 percent slopes; from the Nolan and Taylor county line, 5.5 miles west on Interstate Highway 20, 2.75 miles south on Adrian Road, 0.7 mile south to a ranch house, 1.5 mile southwest on a pasture road, and 0.35 mile northwest:

A1—0 to 7 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; strong fine subangular blocky and granular structure; very hard, firm, sticky and plastic; many fine roots; few broken limestone fragments; limestone boulders cover about 3 percent of the surface; mildly alkaline; abrupt smooth boundary.

B2t—7 to 18 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; mildly alkaline; abrupt smooth boundary.

R—18 to 20 inches; fractured limestone bedrock; hardness of 3 or more on Mohs scale; reddish brown clay in crevices.

The solum is from 14 to 20 inches thick. About 20 percent of the soil surface is covered with cobbles and boulder-size limestone fragments.

The A horizon is 7 to 9 inches thick. It is dark brown, brown, or reddish brown. The Bt horizon is reddish brown or dark reddish brown.

Tarrant series

The Tarrant series consists of very shallow and shallow, clayey soils on uplands. These soils are gently sloping and well drained. They formed in limestone bedrock. Slope ranges from 1 to 8 percent.

Typical pedon of Tarrant stony clay, 1 to 8 percent slopes; from the Nolan and Taylor county line on Interstate Highway 20, 5.5 miles west, 2.75 miles south on Adrian Road, 0.7 mile south to a ranch house, 1.1 miles southwest on a pasture road, and 200 feet north in rangeland:

A11—0 to 9 inches; dark grayish brown (10YR 4/2) stony clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; 50 to 70 percent of surface covered with limestone fragments, about 50 percent are stone-size, 25 percent cobble-size, and about 25 percent by volume is gravel-size limestone fragments; calcareous; moderately alkaline; abrupt smooth boundary.

A12ca—9 to 13 inches; dark brown (10YR 4/3) very cobbly clay, dark brown (10YR 3/3) moist; moderate medium blocky structure; very hard, firm, sticky and plastic; 60 percent by volume gravel, cobble, and stone-size limestone fragments that have thin patchy calcium carbonate coatings and pendants; calcareous; moderately alkaline; abrupt wavy boundary.

R—13 to 18 inches; fractured, indurated limestone bedrock; calcium carbonate coatings on limestone plates; brown (7.5YR 4/2) clay in crevices and between plates.

The solum is 6 to 20 inches thick over fractured indurated limestone. It contains 35 to 85 percent coarse fragments that are about 25 to 35 percent gravel, 25 to 40 percent cobbles, and 25 to 50 percent stones.

The A horizon is 4 to 10 inches thick. It is dark grayish brown, very dark grayish brown, or dark brown.

Texroy series

The Texroy series consists of deep, loamy soils on uplands. These soils are nearly level and well drained. They formed in silty sediments. Slope ranges from 0 to 1 percent.

Typical pedon of Texroy loam, 0 to 1 percent slopes; from the intersection of Texas Loop 432 and Farm Road 419 in Sweetwater, 3.4 miles north on Farm Road 419 to railroad, 0.25 mile east on a gravel road, and 200 feet south in cropland:

Ap—0 to 8 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky and granular structure; hard, firm to friable; many fine roots; many fine pores; mildly alkaline; abrupt smooth boundary.

B1—8 to 17 inches; dark brown (7.5YR 3/2) loam, very dark brown (7.5YR 2/2) moist; moderate medium subangular blocky and granular structure; slightly hard, friable; few fine roots; common fine pores; mildly alkaline; abrupt smooth boundary.

B21t—17 to 24 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable; few fine roots; common fine pores; moderately alkaline; abrupt smooth boundary.

B22t—24 to 34 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist;

moderate medium subangular blocky structure; very hard, firm to friable; few patchy clay films; films and threads of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B23t—34 to 54 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky and granular structure; hard, friable; few threads of calcium carbonate and a few very fine concretions; calcareous; moderately alkaline; gradual smooth boundary.

IIB3—54 to 72 inches; reddish yellow (5YR 6/6) loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; slightly hard, friable; few soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum is from 40 to more than 72 inches thick. Depth to secondary carbonates ranges from 10 to 24 inches below the surface. The mollic epipedon is 20 to 40 inches thick. Reaction is neutral to mildly alkaline in the A horizon, and mildly or moderately alkaline in the B1 and upper Bt horizons.

The A horizon is 6 to 15 inches thick. It is brown or dark brown. The B1 and upper Bt horizons are brown or dark brown. Texture is loam or clay loam. The lower part of the Bt horizon underlying the mollic epipedon and the IIB3 horizon are loam or clay loam. They are reddish brown or brown. The clay content is from 20 to 32 percent. The visible carbonates range from a few threads and films to 5 percent, by volume, in the lower part. The C horizon, if present, is light brown loam or clay loam.

Tillman series

The Tillman series consists of deep, clayey soils on uplands. These soils are nearly level and well drained. They formed in red-bed shaly clay. Slope ranges from 0 to 1 percent.

Typical pedon of Tillman clay loam, 0 to 1 percent slopes; from the intersection of Interstate Highway 20 and Texas Loop 432 east of Sweetwater, 6 miles east on Interstate Highway 20, 1 mile north on an oilfield road, and 100 feet east in rangeland:

A1—0 to 11 inches; reddish brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate fine subangular blocky structure; very hard, firm, sticky and plastic; common fine roots; noncalcareous; moderately alkaline; abrupt smooth boundary.

B21t—11 to 18 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; vertical streaks of reddish brown clay loam in filled cracks; calcareous; moderately alkaline; gradual smooth boundary.

B22t—18 to 24 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; vertical streaks of reddish brown clay loam in filled cracks; calcareous; moderately alkaline; gradual smooth boundary.

B23t—24 to 43 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; calcareous; moderately alkaline; gradual smooth boundary.

B24tca—43 to 62 inches; red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; weak granular structure; hard, friable, slightly sticky and plastic; about 3 percent by volume soft masses of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B3—62 to 80 inches; red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; weak medium subangular blocky structure; very hard, friable, slightly sticky and plastic; calcareous; moderately alkaline.

The solum is 60 inches or more thick. Depth to the calcic horizon is 40 inches or more.

The A horizon is 6 to 13 inches thick. It is reddish brown or dark reddish gray. The B2t horizon is clay or clay loam with clay content of 35 to 50 percent. It is red, reddish brown, or yellowish red. It is calcareous below depths of 10 to 24 inches. The Btca is clay or clay loam. It is red, light red, or yellowish red. Visible calcium carbonate content ranges from 3 to 10 percent, by volume. The C horizon, where present, is massive silty clay loam, clay loam, or shaly clay. It is in varying shades of red, brown, or gray.

Tobosa series

The Tobosa series consists of deep, clayey soils on uplands. These soils are nearly level to gently sloping and well drained. They formed in calcareous clays. Slope ranges from 0 to 3 percent.

Typical pedon of Tobosa clay, 0 to 1 percent slopes; from the Nolan and Taylor county line, 1.25 miles west and south on Farm Road 126, and 100 feet east in a cultivated field:

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate very fine and fine subangular blocky structure; very hard, very firm, very sticky and plastic; calcareous; moderately alkaline; abrupt smooth boundary.

A1—5 to 28 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; very hard, very firm, very sticky and plastic; many fine pores; common grooved intersecting slickensides below 18 inches; calcareous; moderately alkaline; diffuse wavy boundary.

AC—28 to 45 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate fine blocky

structure; very hard, very firm, very sticky and plastic; common grooved intersecting slickensides; few limestone fragments; common fine pores; calcareous; moderately alkaline; gradual wavy boundary.

Cca—45 to 64 inches; light brown (7.5YR 6/4) clay, brown (7.5YR 5/4) moist; massive; very hard, very firm, very sticky and plastic; about 13 percent by volume concretions and soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum is 40 to 80 inches or more thick. When dry the soil has cracks 1 inch or more wide at the surface that extend to depths of 20 inches or more. It has gilgai microrelief with cycles of microknolls and microdepressions repeated every 20 to 25 feet. The microdepressions are 10 to 20 feet in diameter and 1/2 to 1 foot lower than the microknolls.

The A horizon is 14 to 54 inches thick. It is brown, dark brown, or dark grayish brown. Reaction ranges from calcareous in the microknolls to noncalcareous in the microdepressions. The AC horizon is brown or light brown. It is 10 to 32 inches thick. The Cca horizon is light brown, reddish yellow, light yellowish brown, or strong brown. Calcium carbonate content is 3 to 20 percent, by volume. In some pedons the Cca horizon is lacking.

Valera series

The Valera series consists of moderately deep, clayey soils on uplands. These soils are nearly level to gently sloping and well drained. They formed in limestone and caliche. Slope ranges from 0 to 3 percent.

Typical pedon of Valera silty clay, 1 to 3 percent slopes; from the intersection of Texas Highway 70 and Interstate Highway 20 in Sweetwater, 10 miles south on Texas Highway 70, 1 mile southeast on a pasture road, and 100 feet north in rangeland:

A11—0 to 10 inches; dark brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; strong medium subangular blocky structure; hard, firm, sticky and plastic; few gravel-size limestone fragments; many fine roots; calcareous; moderately alkaline; clear smooth boundary.

A12—10 to 21 inches; dark brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate fine blocky structure; hard, firm, sticky and plastic; calcareous; moderately alkaline, abrupt smooth boundary.

B—21 to 25 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate fine blocky structure; hard, firm, sticky and plastic; calcareous; moderately alkaline; abrupt smooth boundary.

Ccam—25 to 27 inches; white (10YR 8/2) strongly cemented caliche with a few soft masses of calcium carbonate.

R—27 to 29 inches; fractured indurated limestone bedrock; crevices filled with calcium carbonate.

The solum is from 20 to 40 inches thick. Coarse fragments of limestone comprise 15 percent or less of the solum. When dry the soil has cracks 1/2 inch to 2 inches wide at the surface that extend to depths of 20 inches or more.

The A horizon is 17 to 25 inches thick. It is dark grayish brown or dark brown. The B horizon, if there is one, is up to 17 inches thick. It is brown or dark brown clay or silty clay. Few films and threads, soft masses, and concretions of calcium carbonate are visible. The Ccam horizon is strongly cemented caliche that ranges from white to yellowish brown. The R horizon is indurated limestone or indurated limestone layered with marl.

Veal series

The Veal series consists of deep, loamy soils on uplands. These soils are gently sloping and well drained. They formed in calcareous, loamy outwash. Slope ranges from 1 to 5 percent (fig. 14).

Typical pedon of Veal loam, 1 to 5 percent slopes; from the intersection of Interstate Highway 20 and U.S. Highway 84 about 2 miles east of Roscoe, 0.3 mile east on Interstate Highway 20, 3.6 miles north on a gravel road, 0.35 mile east on a field road, and 300 feet north in rangeland:

A1—0 to 10 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate fine granular and subangular blocky structure; slightly hard, friable; many fine roots; common fine pores; calcareous; moderately alkaline; clear smooth boundary.

B21—10 to 18 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; common caliche fragments; about 25 percent by volume soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B22ca—18 to 40 inches; very pale brown (10YR 8/3) clay loam, very pale brown (10YR 7/3) moist; weak fine granular structure; hard, friable; few fine roots; about 50 percent by volume concretions and soft masses of calcium carbonate; many concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B23ca—40 to 60 inches; white (5YR 8/1) loam, pinkish gray (5YR 7/2) moist; massive; slightly hard, friable; about 10 percent by volume soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum is 40 to 60 inches or more thick. Depth to the calcic horizon is 10 to 24 inches.

The A horizon is 5 to 10 inches thick. It is brown, grayish brown, or light brown. The B21 horizon is brown, light brown, pale brown, or light yellowish brown. It is loam or clay loam. Soft masses of calcium carbonate

Figure 14.—Profile of Veal loam, 1 to 5 percent slopes, showing high calcium carbonate content in the B horizon.

comprise 15 to 40 percent, by volume. The B2ca is white, light brown, pink, or very pale brown. Soft masses of calcium carbonate comprise 40 to 60 percent, by volume, of the B2ca horizon. Texture is clay loam, loam, or fine sandy loam. It is weakly cemented in some pedons.

Vernon series

The Vernon series consists of moderately deep, clayey soils on uplands. These soils are gently sloping and well drained. They formed in red-bed clays. Slope ranges from 1 to 3 percent.

Typical pedon of Vernon clay, 1 to 3 percent slopes; from the intersection of Interstate Highway 20 and Texas Loop 432 on east side of Sweetwater, 6 miles east on Interstate Highway 20, 1.7 miles north on an oilfield road, and 50 feet west in rangeland:

A1—0 to 12 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; common fine roots; calcareous; moderately alkaline; gradual smooth boundary.

B2—12 to 31 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate medium subangular blocky structure; very hard, very firm; common fine roots; calcareous; moderately alkaline; abrupt smooth boundary.

Cr—31 to 75 inches; red (2.5YR 4/6) shaly clay, dark red (2.5YR 3/6) moist; massive; thin grayish brown seams; calcareous; moderately alkaline.

The solum is 20 to 36 inches thick.

The A horizon is 4 to 12 inches thick. It is red, yellowish red, or reddish brown. Up to 30 percent of the surface is covered by siliceous gravel. The B horizon is red or yellowish red. It is clay or silty clay. The Cr horizon is red shaly clay. Thin strata, 1/8 to 1/4 inch thick, of weakly cemented sandstone are in some pedons. Gray mottles or seams are common.

Volente series

The Volente series consists of deep, clayey soils on uplands. These soils are nearly level to gently sloping and well drained. They formed in calcareous, clayey alluvial-colluvial sediments. Slope ranges from 0 to 5 percent.

Typical pedon of Volente clay loam, in an area of Volente-Gageby complex, 0 to 5 percent slopes; from the intersection of Texas Highway 70 and Interstate Highway 20 in Sweetwater, 9 miles south on Texas Highway 70, and 1.25 miles east in rangeland:

A11—0 to 12 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; strong fine subangular blocky and granular structure; hard, friable, sticky and plastic; few gravel-size limestone fragments on the surface; calcareous; moderately alkaline; clear smooth boundary.

A12—12 to 24 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; strong fine subangular blocky structure; hard, friable, sticky and plastic; 10 percent broken limestone fragments 1/4 inch to 3 inches in diameter; calcareous; moderately alkaline; clear smooth boundary.

B—24 to 38 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; about 10 percent by volume broken limestone fragments 1/4 inch to 3 inches in diameter; calcareous; moderately alkaline; abrupt smooth boundary.

C—38 to 42 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; massive; hard, friable, sticky and plastic; about 20 percent by volume broken limestone fragments that are 60 percent gravel-size and 40 percent cobble-size; calcareous; moderately alkaline; abrupt smooth boundary.

R—42 to 46 inches; indurated limestone bedrock.

The solum is 34 to about 50 inches thick.

The A horizon is dark brown or dark grayish brown. It is clay, silty clay, or clay loam. It is 20 to 40 inches thick. The B horizon is 8 to 20 inches thick. It is brown or brownish yellow. Coarse fragments range from 0 to 15 percent, by volume. The C horizon is brownish yellow or reddish yellow. Coarse fragments range from 0 to 30 percent, by volume.

The Volente soils in this survey area are taxadjuncts to the Volente series because they are dominantly slightly shallower to limestone bedrock than is typical for the series. This difference has not affected the use and management of the soils.

Woodward series

The Woodward series consists of moderately deep, loamy soils on uplands. These soils are gently sloping and well drained. They formed in calcareous red-bed sandstone. Slope ranges from 1 to 5 percent.

Typical pedon of Woodward loam, 1 to 3 percent slopes; from the intersection of Interstate Highway 20 and Texas Highway 70, 0.25 mile south on Texas Highway 70, 0.25 mile east on a county road, and 200 feet north in rangeland:

A1—0 to 8 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and plastic; many fine roots; calcareous; moderately alkaline; clear smooth boundary.

B2—8 to 21 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and plastic; few fine roots; few threads and films of calcium carbonate in the lower part; calcareous; moderately alkaline; abrupt smooth boundary.

B3ca—21 to 31 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable; few fine roots; common threads and films and a few very fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Cr—31 to 54 inches; yellowish red (5YR 5/6) weakly cemented sandstone, yellowish red (5YR 4/6) moist.

The solum is 20 to 40 inches thick. The control section is 10 to 18 percent clay and less than 15 percent sand that is coarser than very fine sand.

The A horizon is 7 to 14 inches thick. It is reddish brown, brown, or yellowish red. The B horizon is reddish brown, brown, yellowish red, reddish yellow, or red. It is loam or silt loam. The Cr horizon is red, yellowish red, or light red. It is weakly to strongly cemented sandstone. Strata of gray, yellowish red, or yellowish brown, strongly cemented sandstone occur in most pedons.

formation of the soils

In this section the factors of soil formation are described and related to the soils in the survey area. The processes of soil formation are explained.

parent material

Parent material is the unconsolidated mass from which soil is formed. It determines the limits of the chemical and mineralogical composition of the soil. The soils of Nolan County have developed from parent materials of Permian, Cretaceous, Tertiary, Quaternary, and Recent geologic ages.

Permian materials in the extreme northeastern and southern parts of the county are mainly red clays and silty clays and red to yellowish brown sandstone. The Knoco and Vernon soils formed in the clayey red beds, and the Woodward and Quinlan soils formed in the silty red beds.

Cretaceous materials are mainly limestone bedrock and interbedded limestone and marl of the Edwards Formation and sandy soils of the Antlers Sand Formation (*3*). The soils that formed in limestone are mainly Ector and Tarrant soils, and those that formed in the sandy materials are mainly Miles soils.

Tertiary materials in the northwestern part of the county make up the nearly level Roscoe Flats of the Ogallala Formation. The Rowena and Roscoe soils developed from these sediments.

Quaternary materials make up the outwash plains of the county. They formed in deposits of Cretaceous sediments underlain by Permian red beds. The major soils that formed in these sediments are the Sagerton and Rotan soils.

Recent materials are sediments that were deposited on the flood plains of streams. Many of these deposits are reworked occasionally by deposition and scouring by floodwaters. The Colorado and Gageby soils formed in these sediments.

climate

The climate of Nolan County is semiarid and fairly uniform. It has had a definite effect on soil formation. Rainfall, evaporation, temperature, and wind are factors of climate that influence soils. There has not been sufficient rainfall to leach the bases from the soils. As a result, most of the soils have a layer in which calcium carbonate has accumulated, and the deep soils are seldom wet below the root zone. The average annual rainfall is 23.50 inches.

Because the winters are mild and the summers are hot, there is continuous decomposition of plants and animals by micro-organisms. Some soils, such as Sagerton, Rotan, and Rowena soils, have a high organic matter content.

plants and animals

Plants, animals, insects, and micro-organisms are important in the formation of soils. Living organisms affect gains or losses in organic matter and plant nutrients in the soil and also the changes in structure and porosity.

Vegetation has an effect on soil formation. The soils in Nolan County are low to high in content of organic matter depending on the kinds of plants that the soils support and the amounts of residue returned to the soil. Organic matter is formed from decaying leaves and stems. When vegetation is limited, therefore, such soils as those of the Miles series are low in organic matter content. The channels left by decaying roots increase soil porosity and permeability.

Insects, such as earthworms and termites, increase porosity by burrowing through the soil and leaving open channels for the movement of water and air. Earthworms help to distribute organic matter to deeper parts of the soil through their castings. Micro-organisms help to decompose organic matter, release nutrients, and add nitrogen to the soil.

relief

Relief, or topography, influences soil development through its effect on drainage and runoff. The topography of Nolan County ranges from nearly level to steep.

The degree of profile development depends on the amount and depth of penetration of water in the soil if other factors of soil formation are equal. Nearly level soils absorb more moisture and generally have better developed profiles than steeper soils. Many of the steeper soils erode almost as fast as they form, even under natural geologic erosion.

The deepest profile development is in the nearly level and gently sloping Miles, Tillman, and Sagerton soils. Shallow development is exemplified by the more sloping

Quinlan and Tarrant soils. The least development is in the undulating to hilly and steep, very shallow, Burson, Ector, Latom, and Lozier soils.

time

A long time is generally required for the formation of soils that have distinct horizons. The length of time that parent materials have been in place is generally reflected in the degree to which the soil profile has developed.

The geological age of soils in Nolan County ranges from young to old. The young soils have undergone very little profile development, while the older soils have well defined horizons. Colorado, Gageby, and Shep soils are among the younger soils lacking profile development. Nipsum soil is darker, and the profile is more developed.

Some of the older soils that formed in calcareous parent material have a prominent accumulation of calcium carbonate, or a calcic horizon, in the lower part of the profile. With further aging, more calcium carbonate leaches down to lower horizons where it accumulates as soft masses or concretions. Rowena and Sagerton soils are examples of soils that have calcic horizons. In other soils the calcium carbonate concentrates in the lower horizons where it becomes cemented or indurated. An indurated, or petrocalcic, horizon requires a long time to form, possibly thousands of years. The Pitzer and Mereta soils are examples of soils that have petrocalcic horizons.

references

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Texas Water Development Board. 1967. Ground Water Resources of Mitchell and Western Nolan Counties, Texas. Rep. 50.

(4) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]

(5) United States Department of Agriculture. 1965. Predicting rainfall-erosion losses from cropland east of the Rocky Mountains. Agr. Res. Serv., U.S. Dep. Agric. Handb. 282, 47 pp.

(6) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Medium	6 to 9
High	9 to 12
Very high	More than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Cement rock. Shaly limestone used in the manufacture of cement.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Potential plant community. The native or introduced plants best adapted to a site.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of

climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-76 at Roscoe, Texas]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average total	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Days with 0.1 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	58.2	30.5	44.4	82	6	43	0.86	---	1.47	2	1.8
February---	62.3	33.8	48.1	85	10	83	1.01	.24	1.62	3	2.4
March------	70.1	40.4	55.3	92	16	240	1.10	.23	1.79	3	1.2
April------	79.2	50.5	64.9	97	28	447	2.37	.54	3.80	4	.0
May--------	85.6	58.5	72.1	103	39	685	2.81	1.09	4.20	5	.0
June-------	92.3	66.4	79.4	105	52	882	2.69	.70	4.28	4	.0
July-------	94.7	69.4	82.1	105	59	995	2.24	.40	3.66	4	.0
August-----	94.0	68.5	81.3	105	58	970	2.05	.36	3.33	4	.0
September--	86.4	62.0	74.3	101	44	729	3.66	1.20	5.65	5	.0
October----	77.7	52.0	64.9	95	33	462	2.60	1.06	3.87	5	.0
November---	65.5	40.5	53.0	85	17	164	1.27	.16	2.09	3	1.0
December---	59.2	32.8	46.0	81	11	48	.84	.06	1.41	2	1.1
Yearly:											
Average--	77.1	50.4	63.8	---	---	---	---	---	---	---	---
Extreme--	---	---	---	107	5	---	---	---	---	---	---
Total----	---	---	---	---	---	5,748	23.50	17.34	29.21	44	7.5

[1] A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-76 at Roscoe, Texas]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 1	April 7	April 14
2 years in 10 later than--	March 25	April 2	April 10
5 years in 10 later than--	March 11	March 24	April 2
First freezing temperature in fall:			
1 year in 10 earlier than--	November 7	November 2	October 25
2 years in 10 earlier than--	November 14	November 7	October 30
5 years in 10 earlier than--	November 27	November 18	November 9

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-76 at Roscoe, Texas]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	230	212	202
8 years in 10	240	221	208
5 years in 10	260	238	220
2 years in 10	280	256	231
1 year in 10	290	265	238

TABLE 4.--SUITABILITIES AND LIMITATIONS OF GENERAL SOIL MAP UNITS FOR SPECIFIED USES

Map unit	Extent of area	Cultivated crops	Rangeland	Urban uses	Recreation
	Pct				
Ector	43	Poorly suited: slope, rooting depth, erosion hazard.	Poorly suited: available water capacity, rooting depth.	Poorly suited: slope, depth to rock.	Poorly suited: slope, small stones, depth to rock.
Potter-Veal-Mereta	15	Poorly suited: slope, available water capacity, erosion hazard, rooting depth.	Moderately well suited: available water capacity, rooting depth.	Moderately well suited: slope, depth to rock, small stones.	Moderately well suited: slope, small stones.
Woodward-Quinlan-Burson	13	Poorly suited: slope, available water capacity, erosion hazard, rooting depth.	Moderately well suited: available water capacity, rooting depth.	Poorly suited: slope, depth to rock.	Poorly suited: slope, depth to rock.
Rowena	10	Well suited------	Well suited------	Poorly suited: shrink-swell, corrosivity, percs slowly.	Moderately well suited: percs slowly.
Sagerton-Rotan-Cobb	9	Well suited------	Well suited------	Moderately well suited: shrink-swell, corrosivity, percs slowly.	Well suited.
Tobosa-Kavett	6	Moderately well suited: clayey texture, droughty.	Moderately well suited: available water capacity, droughty.	Poorly suited: depth to bedrock, shrink-swell, corrosivity, percs slowly.	Poorly suited: percs slowly, too clayey.
Latom-Cobb-Rock outcrop	4	Poorly suited: slope, rooting depth, erosion hazard.	Poorly suited: available water capacity, rooting depth.	Poorly suited: slope, depth to rock.	Poorly suited: slope, depth to rock.

TABLE 5.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Acme-Cottonwood complex, 1 to 5 percent slopes	2,270	0.4
2	Burson-Quinlan association, hilly	13,210	2.2
3	Cobb fine sandy loam, 1 to 5 percent slopes	6,310	1.1
4	Cobb-Miles complex, 0 to 1 percent slopes	420	0.1
5	Cobb-Miles complex, 1 to 3 percent slopes	3,350	0.6
6	Colorado loam, occasionally flooded	1,283	0.2
7	Colorado loam, frequently flooded	7,620	1.3
8	Cosh fine sandy loam, 1 to 5 percent slopes	1,440	0.2
9	Ector very gravelly clay loam, 1 to 8 percent slopes	138,100	23.4
10	Ector-Rock outcrop association, hilly	24,725	4.2
11	Gageby clay loam, occasionally flooded	13,210	2.2
12	Gageby clay loam, frequently flooded	4,570	0.8
13	Kavett clay, 0 to 1 percent slopes	3,740	0.6
14	Kavett clay, 1 to 3 percent slopes	16,790	2.9
15	Knoco clay, 1 to 8 percent slopes	4,400	0.7
16	Latom-Rock outcrop association, rolling	9,260	1.6
17	Lozier-Rock outcrop association, steep	19,640	3.3
18	Mereta clay loam, 0 to 1 percent slopes	1,990	0.3
19	Mereta clay loam, 1 to 3 percent slopes	11,220	1.9
20	Miles loamy fine sand, 0 to 3 percent slopes	1,069	0.2
21	Miles loamy fine sand, 3 to 5 percent slopes	541	0.1
22	Miles fine sandy loam, 1 to 3 percent slopes	4,810	0.8
23	Miles fine sandy loam, 3 to 5 percent slopes	2,600	0.4
24	Nipsum clay loam, 0 to 1 percent slopes	5,290	0.9
25	Nipsum clay loam, 1 to 3 percent slopes	9,150	1.5
26	Paducah loam, 1 to 3 percent slopes	6,860	1.2
27	Paducah loam, 3 to 5 percent slopes	3,940	0.7
28	Pits	1,345	0.2
29	Pitzer gravelly loam, 1 to 8 percent slopes	4,194	0.7
30	Potter gravelly loam, 1 to 20 percent slopes	29,300	5.0
31	Quinlan loam, 1 to 5 percent slopes	12,473	2.1
32	Quinlan-Burson-Woodward association, rolling	5,080	0.9
33	Randall clay	2,830	0.5
34	Roscoe clay	10,670	1.8
35	Rotan clay loam, 0 to 1 percent slopes	3,630	0.6
36	Rotan clay loam, 1 to 3 percent slopes	2,590	0.4
37	Rowena clay loam, 0 to 1 percent slopes	37,180	6.3
38	Rowena clay loam, 1 to 3 percent slopes	15,640	2.6
39	Sagerton clay loam, 0 to 1 percent slopes	9,890	1.7
40	Sagerton clay loam, 1 to 3 percent slopes	11,420	1.9
41	Shep loam, 1 to 5 percent slopes	22,630	3.8
42	Shep loam, 5 to 12 percent slopes	4,140	0.7
43	Spade loam, 1 to 3 percent slopes	2,470	0.4
44	Spade loam, 3 to 5 percent slopes	3,360	0.6
45	Speck clay loam, 0 to 1 percent slopes	940	0.2
46	Speck clay loam, 1 to 3 percent slopes	2,170	0.4
47	Tarrant stony clay, 1 to 8 percent slopes	14,614	2.5
48	Texroy loam, 0 to 1 percent slopes	3,990	0.7
49	Tillman clay loam, 0 to 1 percent slopes	1,270	0.2
50	Tobosa clay, 0 to 1 percent slopes	8,280	1.4
51	Tobosa clay, 1 to 3 percent slopes	5,760	1.0
52	Valera silty clay, 0 to 1 percent slopes	2,040	0.3
53	Valera silty clay, 1 to 3 percent slopes	3,050	0.5
54	Veal loam, 1 to 5 percent slopes	16,050	2.7
55	Vernon clay, 1 to 3 percent slopes	1,250	0.2
56	Volente-Gageby complex, 0 to 5 percent slopes	10,260	1.7
57	Woodward loam, 1 to 3 percent slopes	11,980	2.0
58	Woodward loam, 3 to 5 percent slopes	11,520	2.0
	Water	896	0.2
	Total	590,720	100.0

TABLE 6.--YIELDS PER ACRE OF CROPS

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Cotton lint	Grain sorghum	Wheat
	Lb	Bu	Bu
1---------- Acme-Cottonwood	---	---	---
2:* Burson----------	---	---	---
Quinlan----------	---	---	---
3---------- Cobb	150	15	15
4---------- Cobb-Miles	275	31	20
5---------- Cobb-Miles	225	25	19
6---------- Colorado	225	25	20
7---------- Colorado	---	---	---
8---------- Cosh	---	15	10
9---------- Ector	---	---	---
10:* Ector----------	---	---	---
Rock outcrop.			
11---------- Gageby	300	30	20
12---------- Gageby	---	---	---
13---------- Kavett	---	---	15
14---------- Kavett	---	---	15
15---------- Knoco	---	---	---
16:* Latom----------	---	---	---
Rock outcrop.			
17:* Lozier----------	---	---	---
Rock outcrop.			
18---------- Mereta	200	25	20
19---------- Mereta	150	20	15

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS--Continued

Map symbol and soil name	Cotton lint	Grain sorghum	Wheat
	Lb	Bu	Bu
20---------- Miles	250	25	15
21---------- Miles	---	---	15
22---------- Miles	250	30	20
23---------- Miles	200	25	15
24---------- Nipsum	250	25	15
25---------- Nipsum	250	25	15
26---------- Paducah	225	25	18
27---------- Paducah	200	20	15
28.* Pits			
29---------- Pitzer	---	---	---
30---------- Potter	---	---	---
31---------- Quinlan	---	---	10
32:*			
Quinlan----------	---	---	---
Burson----------	---	---	---
Woodward----------	---	---	---
33---------- Randall	225	30	10
34---------- Roscoe	225	30	20
35---------- Rotan	300	35	25
36---------- Rotan	275	30	20
37---------- Rowena	275	35	25
38---------- Rowena	250	30	25
39---------- Sagerton	275	30	25
40---------- Sagerton	250	25	20

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS--Continued

Map symbol and soil name	Cotton lint	Grain sorghum	Wheat
	Lb	Bu	Bu
41--Shep	150	25	15
42--Shep	---	---	---
43--Spade	175	20	15
44--Spade	---	15	12
45--Speck	---	---	15
46--Speck	---	---	15
47--Tarrant	---	---	---
48--Texroy	350	45	30
49--Tillman	250	30	20
50--Tobosa	250	30	20
51--Tobosa	200	25	20
52--Valera	200	30	20
53--Valera	200	30	20
54--Veal	125	15	10
55--Vernon	---	20	15
56--Volente-Gageby	---	30	25
57--Woodward	225	30	20
58--Woodward	175	25	15

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I (N)	---	---	---	---	---
(I)	13,880	---	---	---	---
II (N)	140,393	61,110	18,340	3,310	57,633
(I)	49,060	29,450	18,340	1,270	---
III (N)	102,759	77,139	10,670	14,950	---
(I)	13,919	13,919	---	---	---
IV (N)	58,879	58,879	---	---	---
(I)	19,281	19,281	---	---	---
V (N)	12,190	---	12,190	---	---
VI (N)	21,121	14,097	2,830	4,194	---
VII (N)	248,559	---	---	248,559	---
VIII (N)	---	---	---	---	---

TABLE 8.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Map symbol and soil name	Range site [name]	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
1:* Acme	Clay Loam	2,200	1,600	1,100
Cottonwood	Gyp	900	600	300
2:* Burson	Very Shallow	1,100	800	500
Quinlan	Loamy Prairie	2,500	1,800	1,300
3---- Cobb	Sandy Loam	3,000	2,400	1,800
4,* 5:* Cobb	Sandy Loam	3,000	2,400	1,800
Miles	Sandy Loam	2,800	2,250	1,800
6, 7---- Colorado	Loamy Bottomland	3,200	2,500	1,800
8---- Cosh	Sandy Loam	2,200	1,750	1,200
9---- Ector	Limestone Hills	1,500	1,200	900
10:* Ector	Steep Rocky	850	550	350
Rock outcrop.				
11, 12---- Gageby	Draw	3,400	2,800	2,000
13, 14---- Kavett	Shallow	3,000	2,500	2,000
15---- Knoco	Shallow Clay	1,400	1,000	600
16:* Latom	Very Shallow	1,000	750	500
Rock outcrop.				
17:* Lozier	Steep Rocky	700	500	300
Rock outcrop.				
18---- Mereta	Shallow	3,000	2,500	2,000
19---- Mereta	Shallow	3,000	2,500	1,800
20, 21---- Miles	Loamy Sand	3,200	2,300	1,500
22, 23---- Miles	Sandy Loam	2,800	2,250	1,800
24, 25---- Nipsum	Clay Loam	2,500	2,100	1,700

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site [name]	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
26, 27---- Paducah	Loamy Prairie----	2,500	2,000	1,500
29---- Pitzer	Very Shallow----	1,500	900	500
30---- Potter	Very Shallow----	900	700	400
31---- Quinlan	Loamy Prairie----	2,500	1,800	1,300
32:*				
Quinlan----	Loamy Prairie----	2,500	1,800	1,300
Burson----	Very Shallow----	1,100	800	500
Woodward----	Loamy Prairie----	2,500	2,000	1,500
33---- Randall	Lakebed----	3,000	1,200	500
34---- Roscoe	Clay Flat----	2,600	2,000	1,500
35, 36---- Rotan	Clay Loam----	2,500	2,000	1,500
37, 38---- Rowena	Clay Loam----	2,500	2,000	1,400
39, 40---- Sagerton	Clay Loam----	2,600	2,000	1,400
41, 42---- Shep	Sandy Loam----	3,000	2,300	1,800
43, 44---- Spade	Sandy Loam----	2,500	2,000	1,500
45, 46---- Speck	Redland----	3,000	2,500	2,000
47---- Tarrant	Low Stony Hills----	2,500	1,800	1,200
48---- Texroy	Clay Loam----	2,500	2,000	1,500
49---- Tillman	Clay Loam----	2,200	1,700	1,200
50, 51---- Tobosa	Clay Flat----	2,500	1,900	1,400
52, 53---- Valera	Clay Loam----	2,600	2,100	1,700
54---- Veal	Loamy----	2,800	2,100	1,400
55---- Vernon	Shallow Clay----	2,000	1,500	1,000
56:*				
Volente----	Clay Loam----	2,700	2,200	1,800
Gageby----	Draw----	3,400	2,800	2,000
57, 58---- Woodward	Loamy Prairie----	2,500	2,000	1,500

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
1:* Acme.					
Cottonwood.					
2:* Burson.					
Quinlan.					
3---------- Cobb	---	Russian-olive, eastern redcedar, Rocky Mountain juniper.	Green ash, osageorange, oriental arborvitae, Arizona cypress.	Siberian elm, honeylocust, Ponderosa pine.	---
4,* 5:* Cobb----------	---	Russian-olive, eastern redcedar, Rocky Mountain juniper.	Green ash, osageorange, oriental arborvitae, Arizona cypress.	Siberian elm, honeylocust, Ponderosa pine.	---
Miles----------	---	Russian-olive, eastern redcedar, Rocky Mountain juniper.	Green ash, osageorange, oriental arborvitae, Arizona cypress.	Siberian elm, honeylocust.	---
6, 7. Colorado					
8---------- Cosh	---	Russian-olive, Rocky Mountain juniper.	Green ash, osageorange, honeylocust.	---	---
9. Ector					
10:* Ector.					
Rock outcrop.					
11, 12---------- Gageby	---	Russian-olive, eastern redcedar.	Green ash, osageorange, oriental arborvitae, Arizona cypress.	Siberian elm, honeylocust.	---
13, 14. Kavett					
15. Knoco					
16:* Latom.					
Rock outcrop.					
17:* Lozier.					
Rock outcrop.					

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
18, 19. Mereta					
20, 21, 22, 23---- Miles	---	Russian-olive, eastern redcedar, Rocky Mountain juniper.	Green ash, osageorange, oriental arborvitae, Arizona cypress.	Siberian elm, honeylocust.	---
24, 25. Nipsum					
26, 27---------- Paducah	---	Russian-olive-----	Green ash, honeylocust, osageorange, eastern redcedar, oriental arborvitae, Arizona cypress.	Siberian elm------	---
28.* Pits					
29. Pitzer					
30. Potter					
31---------- Quinlan	---	Eastern redcedar	---	---	---
32:* Quinlan----------	---	Eastern redcedar	---	---	---
Burson.					
Woodward---------	---	---	Austrian pine, eastern redcedar.	---	---
33. Randall					
34---------- Roscoe	---	Russian-olive, Rocky Mountain juniper.	Green ash, osageorange, arborvitae.	Siberian elm------	---
35, 36---------- Rotan	---	Green ash, osageorange, Russian-olive.	Honeylocust, arborvitae.	Siberian elm------	---
37, 38---------- Rowena	---	Green ash, osageorange, eastern redcedar.	Honeylocust, arborvitae.	Siberian elm------	---
39, 40---------- Sagerton	---	Green ash, osageorange, Russian-olive, eastern redcedar, Arizona cypress.	Honeylocust, oriental arborvitae.	Siberian elm------	---
41, 42. Shep					
43, 44. Spade					

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
45, 46. Speck					
47. Tarrant					
48---------- Texroy	---	---	---	Austrian pine, red mulberry, eastern redcedar, ponderosa pine.	Eastern cottonwood, loblolly pine.
49---------- Tillman	---	Eastern redcedar, osageorange.	Honeylocust, Chinese elm.	---	---
50, 51---------- Tobosa	---	Russian-olive, oriental arborvitae.	Green ash, osageorange, Arizona cypress.	Siberian elm, honeylocust.	---
52, 53---------- Valera	---	Russian-olive, oriental arborvitae.	Green ash, eastern redcedar, osageorange, Arizona cypress.	Siberian elm, honeylocust.	---
54---------- Veal	---	Oriental arborvitae, Rocky Mountain juniper, Russian-olive, osageorange, eastern redcedar.	Honeylocust, Siberian elm.	---	---
55---------- Vernon	---	Eastern redcedar	---	---	---
56:* Volente----------	---	---	Eastern redcedar, osageorange.	Green ash, pecan, Arizona cypress.	Siberian elm, honeylocust.
Gageby----------	---	Russian-olive, eastern redcedar.	Green ash, osageorange, oriental arborvitae, Arizona cypress.	Siberian elm, honeylocust.	---
57, 58---------- Woodward	---	---	Austrian pine, eastern redcedar.	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1:*					
Acme	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: thin layer.
Cottonwood	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope, dusty.	Severe: slope, thin layer.
2:*					
Burson	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.	Severe: thin layer.
Quinlan	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.	Severe: slope, thin layer.
3---- Cobb	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: thin layer.
4:*					
Cobb	Slight	Slight	Slight	Slight	Moderate: thin layer.
Miles	Slight	Slight	Slight	Slight	Slight.
5:*					
Cobb	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: thin layer.
Miles	Slight	Slight	Moderate: slope.	Slight	Slight.
6---- Colorado	Severe: floods.	Slight	Slight	Slight	Slight.
7---- Colorado	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
8---- Cosh	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: thin layer.
9---- Ector	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones.	Severe: small stones.	Severe: small stones, thin layer.
10:*					
Ector	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones.	Severe: small stones.	Severe: small stones, thin layer.
Rock outcrop.					
11---- Gageby	Severe: floods.	Slight	Moderate: floods.	Slight	Moderate: floods.
12---- Gageby	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
13, 14---- Kavett	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Moderate: too clayey.	Severe: thin layer, too clayey.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
15--Knoco	Severe: depth to rock.	Severe: depth to rock.	Severe: too clayey, depth to rock.	Moderate: too clayey.	Severe: droughty, thin layer.
16:*					
Latom	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: thin layer.
Rock outcrop.					
17:*					
Lozier	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones.	Severe: small stones, slope, thin layer.
Rock outcrop.					
18, 19--Mereta	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Slight	Severe: thin layer.
20--Miles	Slight	Slight	Slight	Slight	Slight.
21, 22, 23--Miles	Slight	Slight	Moderate: slope.	Slight	Slight.
24--Nipsum	Slight	Slight	Slight	Slight	Slight.
25--Nipsum	Slight	Slight	Moderate: slope.	Slight	Slight.
26, 27--Paducah	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
28.* Pits					
29--Pitzer	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.	Slight	Severe: thin layer.
30--Potter	Moderate: small stones, slope.	Moderate: small stones, slope.	Severe: slope, small stones.	Moderate: dusty.	Severe: droughty.
31--Quinlan	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: thin layer.
32:*					
Quinlan	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: thin layer.
Burson	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.	Severe: thin layer.
Woodward	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope, thin layer.
33--Randall	Severe: ponding.	Severe: ponding.	Severe: too clayey, ponding.	Severe: ponding.	Severe: ponding, too clayey.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
34--Roscoe	Severe: ponding.	Severe: ponding.	Severe: too clayey, ponding.	Severe: ponding.	Severe: ponding, too clayey.
35--Rotan	Slight	Slight	Slight	Slight	Slight.
36--Rotan	Slight	Slight	Moderate: slope.	Slight	Slight.
37--Rowena	Slight	Slight	Slight	Slight	Slight.
38--Rowena	Slight	Slight	Moderate: slope.	Slight	Slight.
39--Sagerton	Slight	Slight	Slight	Slight	Slight.
40--Sagerton	Slight	Slight	Moderate: slope.	Slight	Slight.
41--Shep	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
42--Shep	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
43--Spade	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: thin layer.
44--Spade	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: thin layer.
45, 46--Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: thin layer.
47--Tarrant	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, small stones, depth to rock.	Severe: large stones.	Severe: large stones, thin layer, too clayey.
48--Texroy	Slight	Slight	Slight	Severe: erodes easily.	Slight.
49--Tillman	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Severe: too clayey.
50--Tobosa	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.
51--Tobosa	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey.	Moderate: too clayey.	Severe: too clayey.
52, 53--Valera	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.	Severe: too clayey.
54--Veal	Slight	Slight	Moderate: slope.	Slight	Slight.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
55--- Vernon	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: percs slowly, slope.	Moderate: too clayey.	Severe: too clayey.
56:* Volente---	Slight---	Slight---	Moderate: slope.	Slight---	Slight.
Gageby---	Severe: floods.	Slight---	Moderate: floods.	Slight---	Moderate: floods.
57, 58--- Woodward	Slight---	Slight---	Moderate: slope, depth to rock.	Severe: erodes easily.	Moderate: thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
1:*									
Acme	Poor	Poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
Cottonwood	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
2:*									
Burson	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Quinlan	Poor	Poor	Fair	Poor	Very poor	Very poor	Fair	Very poor	Fair.
3---- Cobb	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
4,* 5:*									
Cobb	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Miles	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
6---- Colorado	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Good.
7---- Colorado	Very poor	Poor	Fair	Good	Poor	Very poor	Poor	Very poor	Good.
8---- Cosh	Poor	Poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
9---- Ector	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
10:*									
Ector	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Rock outcrop.									
11---- Gageby	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
12---- Gageby	Very poor	Poor	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.
13, 14---- Kavett	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
15---- Knoco	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
16:*									
Latom	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Rock outcrop.									
17:*									
Lozier	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Rock outcrop.									
18, 19---- Mereta	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
20, 21---------- Miles	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
22, 23---------- Miles	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
24, 25---------- Nipsum	Good	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
26---------- Paducah	Good	Good	Fair	Fair	Very poor	Very poor	Good	Very poor	Fair.
27---------- Paducah	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
28.* Pits									
29---------- Pitzer	Poor	Poor	Poor	Poor	Poor	Very poor	Poor	Very poor	Poor.
30---------- Potter	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
31---------- Quinlan	Poor	Poor	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
32:* Quinlan----------	Poor	Poor	Fair	Poor	Very poor	Very poor	Fair	Very poor	Fair.
Burson----------	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Woodward----------	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
33---------- Randall	Poor	Poor	Fair	Poor	Poor	Fair	Poor	Poor	Poor.
34---------- Roscoe	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair.
35, 36---------- Rotan	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
37, 38---------- Rowena	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
39, 40---------- Sagerton	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
41---------- Shep	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
42---------- Shep	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
43, 44---------- Spade	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
45, 46---------- Speck	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
47---------- Tarrant	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
48---------- Texroy	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
49---------- Tillman	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
50, 51---------- Tobosa	Fair	Fair	Poor	Fair	Poor	Very poor	Fair	Very poor	Poor.
52, 53---------- Valera	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
54---------- Veal	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
55---------- Vernon	Fair	Fair	Poor	Fair	Poor	Very poor	Fair	Very poor	Fair.
56:*									
Volente----------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Gageby----------	Good	Good	Good	Good	Very poor	Very poor	Poor	Very poor	Fair.
57, 58---------- Woodward	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1:*						
Acme	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Severe: low strength.	Severe: thin layer.
Cottonwood	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
2:*						
Burson	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: thin layer.
Quinlan	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
3---- Cobb	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Slight	Moderate: thin layer.
4,* 5:*						
Cobb	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Slight	Moderate: thin layer.
Miles	Slight	Slight	Slight	Slight	Slight	Slight.
6---- Colorado	Slight	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength.	Slight.
7---- Colorado	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Severe: floods.
8---- Cosh	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
9---- Ector	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, thin layer.
10:*						
Ector	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: small stones, thin layer.
Rock outcrop.						
11---- Gageby	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Moderate: floods.
12---- Gageby	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Severe: floods.
13, 14---- Kavett	Severe: depth to rock, cemented pan.	Severe: shrink-swell, depth to rock, cemented pan.	Severe: depth to rock, cemented pan, shrink-swell.	Severe: shrink-swell, depth to rock, cemented pan.	Severe: depth to rock, cemented pan, low strength.	Severe: thin layer, too clayey.
15---- Knoco	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: droughty, thin layer.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
16:*						
Latom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Severe: thin layer.
Rock outcrop.						
17:*						
Lozier	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: small stones, slope, thin layer.
Rock outcrop.						
18, 19--- Mereta	Severe: cemented pan.	Moderate: shrink-swell, cemented pan.	Severe: cemented pan.	Moderate: shrink-swell, cemented pan.	Severe: low strength.	Severe: thin layer.
20--- Miles	Slight---	Slight---	Slight---	Slight---	Slight---	Slight.
21--- Miles	Slight---	Slight---	Slight---	Moderate: slope.	Slight---	Slight.
22--- Miles	Slight---	Slight---	Slight---	Slight---	Slight---	Slight.
23--- Miles	Slight---	Slight---	Slight---	Moderate: slope.	Slight---	Slight.
24, 25--- Nipsum	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
26--- Paducah	Slight---	Slight---	Slight---	Slight---	Severe: low strength.	Slight.
27--- Paducah	Slight---	Slight---	Slight---	Moderate: slope.	Severe: low strength.	Slight.
28.* Pits						
29--- Pitzer	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: slope, cemented pan.	Moderate: cemented pan.	Severe: thin layer.
30--- Potter	Moderate: large stones, slope.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, large stones.	Severe: droughty.
31--- Quinlan	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
32:*						
Quinlan	Severe: depth to rock.	Moderate: depth to rock, slope.	Severe: depth to rock.	Severe: slope.	Moderate: slope.	Severe: thin layer.
Burson	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: thin layer.
Woodward	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope, low strength.	Moderate: slope, thin layer.
33--- Randall	Severe: cutbanks cave, ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: ponding, too clayey.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
34---------- Roscoe	Severe: cutbanks cave, ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: ponding, too clayey.
35, 36---------- Rotan	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
37, 38---------- Rowena	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
39, 40---------- Sagerton	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
41---------- Shep	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: low strength.	Slight.
42---------- Shep	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope.	Moderate: slope.
43---------- Spade	Moderate: depth to rock.	Slight---------	Moderate: depth to rock.	Slight---------	Slight---------	Moderate: thin layer.
44---------- Spade	Moderate: depth to rock.	Slight---------	Moderate: depth to rock.	Moderate: slope.	Slight---------	Moderate: thin layer.
45, 46---------- Speck	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: thin layer.
47---------- Tarrant	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, low strength.	Severe: large stones, thin layer, too clayey.
48---------- Texroy	Slight---------	Slight---------	Slight---------	Slight---------	Severe: low strength.	Slight.
49---------- Tillman	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
50, 51---------- Tobosa	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
52, 53---------- Valera	Severe: depth to rock, cemented pan.	Severe: shrink-swell.	Severe: depth to rock, cemented pan, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
54---------- Veal	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: low strength.	Slight.
55---------- Vernon	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
56:* Volente----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Gageby----------	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Moderate: floods.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
57---------- Woodward	Moderate: depth to rock.	Slight----------	Moderate: depth to rock.	Slight----------	Moderate: low strength.	Moderate: thin layer.
58---------- Woodward	Moderate: depth to rock.	Slight----------	Moderate: depth to rock.	Moderate: slope.	Moderate: low strength.	Moderate: thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1:*					
Acme	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Cottonwood	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope, thin layer.
2:*					
Burson	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, thin layer, slope.
Quinlan	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope, thin layer.
3---- Cobb	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
4:*					
Cobb	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Miles	Slight	Moderate: seepage.	Slight	Slight	Good.
5:*					
Cobb	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Miles	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
6---- Colorado	Moderate: floods, percs slowly.	Severe: floods.	Moderate: floods.	Moderate: floods.	Good.
7---- Colorado	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
8---- Cosh	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
9---- Ector	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
10:*					
Ector	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Rock outcrop.					

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
11, 12--Gageby	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
13, 14--Kavett	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan, too clayey.	Severe: depth to rock, cemented pan.	Poor: area reclaim, too clayey, hard to pack.
15--Knoco	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
16:*					
Latom	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Rock outcrop.					
17:*					
Lozier	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope, thin layer.
Rock outcrop.					
18, 19--Mereta	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan, too clayey.	Moderate: cemented pan.	Poor: area reclaim, hard to pack.
20--Miles	Slight	Moderate: seepage.	Slight	Slight	Good.
21, 22, 23--Miles	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
24--Nipsum	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
25--Nipsum	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
26, 27--Paducah	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
28.* Pits					
29--Pitzer	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Poor: area reclaim.
30--Potter	Moderate: percs slowly, slope, large stones.	Severe: seepage, slope.	Severe: large stones.	Moderate: slope.	Poor: small stones.
31--Quinlan	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
32:*					
Quinlan	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
32:*					
Burson	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Woodward	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
33--- Randall	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
34--- Roscoe	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
35--- Rotan	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
36--- Rotan	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
37--- Rowena	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
38--- Rowena	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
39--- Sagerton	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
40--- Sagerton	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
41--- Shep	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
42--- Shep	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
43, 44--- Spade	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Poor: area reclaim, thin layer.
45, 46--- Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
47--- Tarrant	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, too clayey, large stones.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
48--- Texroy	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
49--- Tillman	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
50---------- Tobosa	Severe: percs slowly.	Slight----------	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
51---------- Tobosa	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
52, 53---------- Valera	Severe: depth to rock, cemented pan, percs slowly.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan, too clayey.	Severe: depth to rock, cemented pan.	Poor: area reclaim, too clayey, hard to pack.
54---------- Veal	Slight----------	Moderate: slope, seepage.	Slight----------	Slight----------	Fair: too clayey.
55---------- Vernon	Severe: percs slowly.	Moderate: slope.	Severe: depth to rock, too clayey.	Slight----------	Poor: area reclaim, too clayey, hard to pack.
56:* Volente----------	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Poor: hard to pack.
Gageby----------	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
57, 58---------- Woodward	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1:*				
Acme	Poor: area reclaim, low strength, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
Cottonwood	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
2:*				
Burson	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
Quinlan	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope, thin layer.
3				
Cobb	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
4,* 5:*				
Cobb	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
Miles	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
6, 7				
Colorado	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
8				
Cosh	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
9				
Ector	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
10:*				
Ector	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
Rock outcrop.				
11, 12				
Gageby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
13, 14				
Kavett	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey.
15				
Knoco	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
16:*				
Latom	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
Rock outcrop.				
17:*				
Lozier	Poor: area reclaim, thin layer, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
18, 19 Mereta	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
20, 21 Miles	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
22, 23 Miles	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
24, 25 Nipsum	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
26, 27 Paducah	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
28.* Pits				
29 Pitzer	Good	Improbable: excess fines.	Probable: source.	Poor: area reclaim, small stones.
30 Potter	Fair: large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
31 Quinlan	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
32:*				
Quinlan	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
Burson	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
Woodward	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer, slope.
33 Randall	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
34 Roscoe	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
35, 36 Rotan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
37, 38--- Rowena	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
39, 40--- Sagerton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
41--- Shep	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
42--- Shep	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
43, 44--- Spade	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
45, 46--- Speck	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
47--- Tarrant	Poor: area reclaim, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, too clayey, large stones.
48--- Texroy	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
49--- Tillman	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.
50, 51--- Tobosa	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
52, 53--- Valera	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
54--- Veal	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
55--- Vernon	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
56:*				
Volente---	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Gageby---	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
57, 58--- Woodward	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Map symbol and soil name	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Irrigation	Terraces and diversions	Grassed waterways
1:*						
Acme	Severe: depth to rock, seepage.	Severe: thin layer, piping.	Severe: no water.	Depth to rock, slope.	Depth to rock	Depth to rock.
Cottonwood	Severe: seepage, depth to rock, slope.	Severe: thin layer.	Severe: no water.	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
2:*						
Burson	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Quinlan	Severe: depth to rock, slope.	Severe: piping, thin layer.	Severe: no water.	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
3---- Cobb	Moderate: seepage, depth to rock, slope.	Severe: piping.	Severe: no water.	Soil blowing, depth to rock.	Depth to rock, soil blowing.	Depth to rock.
4,* 5:*						
Cobb	Moderate: seepage, depth to rock.	Severe: piping.	Severe: no water.	Soil blowing, depth to rock.	Depth to rock, soil blowing.	Depth to rock.
Miles	Moderate: seepage.	Moderate: piping.	Severe: no water.	Soil blowing---	Soil blowing---	Favorable.
6---- Colorado	Severe: seepage.	Moderate: piping.	Severe: no water.	Favorable------	Favorable------	Favorable.
7---- Colorado	Severe: seepage.	Moderate: piping.	Severe: no water.	Floods---------	Floods---------	Favorable.
8---- Cosh	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
9---- Ector	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Large stones, depth to rock, slope.	Large stones, depth to rock.	Large stones, depth to rock.
10:*						
Ector	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Rock outcrop.						
11---- Gageby	Moderate: seepage.	Moderate: piping.	Severe: no water.	Favorable------	Favorable------	Favorable.
12---- Gageby	Moderate: seepage.	Moderate: piping.	Severe: no water.	Floods---------	Floods---------	Favorable.
13, 14---- Kavett	Severe: depth to rock, cemented pan.	Severe: thin layer.	Severe: no water.	Slow intake, depth to rock, cemented pan.	Depth to rock, cemented pan.	Depth to rock, cemented pan.
15---- Knoco	Slight---------	Moderate: hard to pack.	Severe: no water.	Droughty, slow intake, percs slowly.	Depth to rock, percs slowly.	Droughty, depth to rock.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Irrigation	Terraces and diversions	Grassed waterways
16:*						
Latom	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Soil blowing, depth to rock, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
Rock outcrop.						
17:*						
Lozier	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Droughty, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop.						
18, 19--- Mereta	Severe: cemented pan, seepage.	Severe: thin layer.	Severe: no water.	Cemented pan---	Cemented pan---	Cemented pan.
20--- Miles	Moderate: seepage.	Moderate: piping.	Severe: no water.	Fast intake, soil blowing.	Soil blowing---	Favorable.
21--- Miles	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Fast intake, soil blowing, slope.	Soil blowing---	Favorable.
22--- Miles	Moderate: seepage.	Moderate: piping.	Severe: no water.	Soil blowing---	Soil blowing---	Favorable.
23--- Miles	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Soil blowing, slope.	Soil blowing---	Favorable.
24, 25--- Nipsum	Slight---	Slight---	Severe: no water.	Percs slowly---	Percs slowly---	Percs slowly.
26--- Paducah	Moderate: seepage.	Severe: piping.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
27--- Paducah	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Slope, erodes easily.	Erodes easily	Erodes easily.
28.* Pits						
29--- Pitzer	Severe: seepage, cemented pan.	Severe: seepage.	Severe: no water.	Cemented pan, slope.	Cemented pan---	Cemented pan.
30--- Potter	Severe: seepage, slope.	Severe: large stones.	Severe: no water.	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
31--- Quinlan	Severe: depth to rock.	Severe: piping, thin layer.	Severe: no water.	Depth to rock, slope.	Depth to rock	Depth to rock.
32:*						
Quinlan	Severe: depth to rock, slope.	Severe: piping, thin layer.	Severe: no water.	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Burson	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Woodward	Severe: slope.	Severe: piping.	Severe: no water.	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Irrigation	Terraces and diversions	Grassed waterways
33---------- Randall	Slight---------	Severe: hard to pack, ponding.	Severe: no water.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Percs slowly.
34---------- Roscoe	Slight---------	Severe: hard to pack, ponding.	Severe: no water.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Percs slowly.
35, 36---------- Rotan	Moderate: seepage.	Moderate: hard to pack.	Severe: no water.	Favorable------	Favorable------	Favorable.
37, 38---------- Rowena	Slight---------	Moderate: hard to pack.	Severe: no water.	Favorable------	Favorable------	Favorable.
39, 40---------- Sagerton	Slight---------	Moderate: piping.	Severe: no water.	Favorable------	Favorable------	Favorable.
41---------- Shep	Severe: seepage, slope.	Moderate: piping.	Severe: no water.	Slope----------	Favorable------	Favorable.
42---------- Shep	Severe: seepage, slope.	Moderate: piping.	Severe: no water.	Slope----------	Slope----------	Slope.
43---------- Spade	Severe: seepage.	Severe: piping.	Severe: no water.	Soil blowing, depth to rock.	Depth to rock, soil blowing.	Depth to rock.
44---------- Spade	Severe: seepage.	Severe: piping.	Severe: no water.	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
45, 46---------- Speck	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
47---------- Tarrant	Severe: depth to rock.	Severe: thin layer, hard to pack, large stones.	Severe: no water.	Large stones, slow intake, depth to rock.	Large stones, depth to rock.	Large stones, depth to rock.
48---------- Texroy	Moderate: seepage.	Moderate: piping.	Severe: no water.	Favorable------	Favorable------	Favorable.
49---------- Tillman	Slight---------	Moderate: hard to pack.	Severe: no water.	Percs slowly, slow intake.	Percs slowly---	Percs slowly.
50, 51---------- Tobosa	Slight---------	Severe: hard to pack.	Severe: no water.	Slow intake, percs slowly.	Percs slowly---	Percs slowly.
52, 53---------- Valera	Severe: depth to rock, cemented pan.	Severe: hard to pack.	Severe: no water.	Slow intake, depth to rock, cemented pan.	Depth to rock, cemented pan.	Depth to rock, cemented pan.
54---------- Veal	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Slope----------	Favorable------	Slope.
55---------- Vernon	Slight---------	Moderate: hard to pack.	Severe: no water.	Droughty, slow intake, percs slowly.	Depth to rock, percs slowly.	Droughty, depth to rock, percs slowly.
56:* Volente----------	Moderate: seepage, slope.	Severe: hard to pack.	Severe: no water.	Slope----------	Favorable------	Favorable.
Gageby----------	Moderate: seepage.	Moderate: piping.	Severe: no water.	Floods---------	Floods---------	Favorable.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Irrigation	Terraces and diversions	Grassed waterways
57---------- Woodward	Moderate: seepage, depth to rock.	Severe: piping.	Severe: no water.	Depth to rock, erodes easily.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
58---------- Woodward	Moderate: seepage, depth to rock, slope.	Severe: piping.	Severe: no water.	Depth to rock, slope, erodes easily.	Depth to rock, erodes easily.	Erodes easily, depth to rock.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Map symbol and soil name	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1:*											
Acme	0-18	Loam	CL, CL-ML	A-4, A-6	0	95-100	90-100	80-98	60-90	24-40	7-22
	18-30	Weathered bedrock	---	---	---	---	---	---	---	---	---
Cottonwood	0-8	Loam	CL, CL-ML	A-4, A-6	0	98-100	95-100	85-100	55-75	20-35	4-15
	8-22	Weathered bedrock	---	---	0	---	---	---	---	---	---
2:*											
Burson	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	95-100	90-100	80-100	50-85	18-30	3-12
	7-36	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Quinlan	0-13	Very fine sandy loam.	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	13-44	Weathered bedrock	---	---	---	---	---	---	---	---	---
3---------- Cobb	0-7	Fine sandy loam	SM, SM-SC, SC	A-2-4, A-4	0	90-100	90-100	75-95	30-49	17-25	3-8
	7-38	Sandy clay loam	SC, CL, SM-SC, CL-ML	A-6, A-4	0	90-100	85-100	75-98	40-60	20-40	7-22
	38-42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
4,* 5:*											
Cobb	0-7	Fine sandy loam	SM, SM-SC, SC	A-2-4, A-4	0	90-100	90-100	75-95	30-49	17-25	3-8
	7-38	Sandy clay loam	SC, CL, SM-SC, CL-ML	A-6, A-4	0	90-100	85-100	75-98	40-60	20-40	7-22
	38-42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Miles	0-10	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-2-4, A-4	0	95-100	90-100	80-98	25-55	18-25	2-7
	10-63	Sandy clay loam, clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-6, A-2-4, A-2-6	0	95-100	90-100	90-98	30-72	20-40	4-22
6, 7---------- Colorado	0-64	Loam, clay loam, sandy clay loam.	CL	A-6, A-7-6	0-2	85-100	80-100	60-100	55-95	29-43	10-28
8---------- Cosh	0-5	Fine sandy loam	SM, SM-SC	A-2-4, A-4	0-5	90-100	90-100	70-90	30-49	15-25	2-7
	5-14	Sandy clay loam	SC, CL	A-6, A-4	0-5	90-98	90-98	80-95	40-55	25-36	8-18
	14-24	Weathered bedrock	---	---	---	---	---	---	---	---	---
9---------- Ector	0-12	Very gravelly clay loam.	GC, GM-GC, SC, GM	A-2-4, A-4, A-6, A-7-6	10-35	30-72	25-60	20-52	13-46	25-49	7-25
	12-18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
10:*											
Ector	0-6	Very gravelly clay loam.	GC, GM-GC, SC, GM	A-2-4, A-4, A-6, A-7-6	10-35	30-72	25-60	20-52	13-46	25-49	7-25
	6-18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
11, 12---------- Gageby	0-64	Clay loam	CL	A-4, A-6	0	95-100	90-100	85-100	51-90	25-40	8-24

See footnote at end of table.

TABLE 16--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
13, 14 Kavett	0-16	Clay	CH	A-7-6	0-2	90-100	80-100	75-100	70-96	51-66	25-40
	16-24	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
15 Knoco	0-8	Clay	CL, CH	A-7-6, A-6	0-5	90-100	90-100	90-100	80-98	32-60	14-38
	8-30	Weathered bedrock	CL, CH	A-7-6, A-6	0-5	90-100	85-100	60-100	60-95	30-60	13-38
16:* Latom	0-5	Fine sandy loam	SM, SM-SC	A-4, A-2-4	0-5	80-100	75-98	70-90	25-45	<25	NP-7
	5-12	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
17:* Lozier	0-5	Very gravelly loam.	GC, GM-GC	A-2-4, A-4, A-6	5-20	40-80	30-70	25-65	20-60	25-35	8-15
	5-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
18, 19 Mereta	0-18	Clay loam	CL, CH	A-6, A-7-6	0-5	90-100	83-100	80-97	60-85	39-52	19-30
	18-22	Variable, cemented.	---	---	---	---	---	---	---	---	---
	22-40	Variable, marl	---	---	---	---	---	---	---	---	---
20, 21 Miles	0-8	Loamy fine sand	SM, SM-SC	A-2-4	0	95-100	90-100	80-98	15-35	<22	NP-4
	8-80	Sandy clay loam, clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-6, A-2-4, A-2-6	0	95-100	90-100	90-98	30-72	20-40	4-22
22, 23 Miles	0-10	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-2-4, A-4	0	95-100	90-100	80-98	25-55	18-25	2-7
	10-63	Sandy clay loam, clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-6, A-2-4, A-2-6	0	95-100	90-100	90-98	30-72	20-40	4-22
24, 25 Nipsum	0-60	Clay loam, clay, silty clay.	CL	A-7-6	0-2	98-100	90-100	90-100	80-95	40-49	20-30
26, 27 Paducah	0-7	Loam	CL, ML, CL-ML	A-4, A-6	0	100	98-100	90-100	51-90	20-32	3-15
	7-42	Loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	60-95	25-40	5-20
	42-54	Very fine sandy loam, loam, silt loam.	CL, ML, CL-ML	A-4, A-6	0	98-100	90-100	85-100	51-85	20-35	3-20
	54-68	Weathered bedrock	---	---	---	---	---	---	---	---	---
28.* Pits											
29 Pitzer	0-6	Gravelly loam	CL	A-4, A-6	0-3	65-95	60-90	55-85	51-70	25-40	8-21
	6-12	Cemented	---	---	---	---	---	---	---	---	---
	12-54	Variable	---	---	---	---	---	---	---	---	---
30 Potter	0-5	Gravelly loam	CL, CL-ML	A-4, A-6	0-5	70-95	70-95	60-85	51-70	20-40	5-20
	5-80	Variable	GC, SC, GM-GC, SM-SC	A-2-4, A-4, A-6, A-2-6	5-50	30-80	25-75	20-60	13-50	20-40	5-20
31 Quinlan	0-13	Loam	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	13-44	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
32:*											
Quinlan	0-11	Loam	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	11-44	Weathered bedrock	---	---	---	---	---	---	---	---	---
Burson	0-6	Loam	ML, CL, CL-ML	A-4, A-6	0	95-100	90-100	80-100	50-85	18-30	3-12
	6-36	Weathered bedrock, variable.	---	---	---	---	---	---	---	---	---
Woodward	0-24	Loam	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	24-54	Weathered bedrock	---	---	---	---	---	---	---	---	---
33---- Randall	0-80	Clay	CL, CH	A-7-6	0	100	100	95-100	75-98	41-70	22-45
34---- Roscoe	0-45	Clay	CL, CH	A-7-6	0-2	98-100	95-100	90-100	75-95	48-70	28-49
	45-75	Clay	CL, CH	A-7-6	0-2	98-100	95-100	90-100	70-95	46-60	28-40
35, 36---- Rotan	0-9	Clay loam	CL	A-4, A-6	0	98-100	95-100	90-100	60-90	25-35	8-16
	9-50	Clay, clay loam, silty clay loam.	CL, CH	A-7	0	98-100	95-100	90-100	70-95	35-58	20-38
	50-66	Clay loam, clay	CL	A-6, A-7-6	0	90-100	85-100	80-98	65-95	35-50	18-30
37, 38---- Rowena	0-12	Clay loam	CL	A-6, A-7-6	0	95-100	90-100	85-100	70-85	35-50	15-30
	12-38	Clay, clay loam	CH, CL	A-7-6	0	95-100	95-100	90-100	75-95	41-55	25-35
	38-69	Clay, clay loam, silty clay loam.	CH, CL	A-6, A-7-6	0	85-100	75-100	65-90	55-85	32-55	14-28
39, 40---- Sagerton	0-10	Clay loam	CL	A-6, A-4	0	95-100	95-100	90-100	55-80	25-35	8-18
	10-53	Clay loam, clay	CL	A-6, A-7-6	0	95-100	95-100	90-100	65-95	36-50	18-30
	53-68	Clay loam, clay	CL	A-6, A-4	0	90-100	90-100	80-100	60-85	25-40	8-22
41, 42---- Shep	0-22	Loam	CL, SC	A-4, A-6	0-2	85-100	80-100	75-95	40-75	25-40	9-21
	22-60	Loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6	0-2	85-100	80-100	70-95	40-75	25-40	9-21
43---- Spade	0-28	Fine sandy loam	SM, SM-SC	A-4, A-2-4	0	100	98-100	75-90	30-49	15-25	1-7
	28-48	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
44---- Spade	0-28	Loam	SM, SM-SC	A-4, A-2-4	0	100	98-100	75-90	30-49	15-25	1-7
	28-48	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
45, 46---- Speck	0-7	Clay loam	CL	A-6, A-7-6	0	90-100	90-100	80-95	70-90	30-45	15-25
	7-18	Clay, clay loam	CL, CH	A-7-6	0	85-100	80-100	70-100	55-95	45-65	25-40
	18-20	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
47---- Tarrant	0-9	Very cobbly clay	CH, GC, SC, GM	A-7-6, A-7-5	33-77	55-100	51-100	48-99	36-95	51-75	26-41
	9-13	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
48---- Texroy	0-17	Loam	ML, CL-ML, CL	A-6, A-7-6	0	100	100	95-100	65-85	25-45	11-27
	17-54	Clay loam, loam	CL	A-6, A-7-6	0	100	100	95-100	65-90	25-45	11-25
	54-72	Loam	SM-SC, CL-ML, CL	A-4, A-6	0	100	100	95-100	30-70	20-45	6-25

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
49---------- Tillman	0-11	Clay loam--------	CL	A-6, A-7-6	0	100	95-100	90-100	70-95	30-50	15-30
	11-43	Clay, clay loam	CL, CH	A-6, A-7-6	0	95-100	90-100	90-98	70-98	38-60	20-38
	43-80	Clay, clay loam, silty clay.	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-98	60-95	30-60	15-38
50, 51---------- Tobosa	0-45	Clay----------	CH	A-7-6	0-5	80-100	75-100	75-100	75-98	51-72	30-45
	45-64	Clay, silty clay	CH, CL	A-7-6	0-5	80-100	75-100	75-100	70-95	45-65	25-40
52, 53---------- Valera	0-25	Silty clay-------	CL, CH	A-7-6	0-2	85-100	75-100	75-95	75-90	41-62	20-38
	25-27	Cemented---------	---	---	---	---	---	---	---	---	---
	27-29	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
54---------- Veal	0-10	Loam----------	CL, CL-ML, SC, SM-SC	A-4, A-6	0	90-100	85-100	70-98	36-75	20-35	5-17
	10-18	Sandy clay loam, clay loam, loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-2	85-100	80-100	80-100	40-80	22-40	7-20
	18-60	Clay loam, sandy clay loam, loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-2	85-100	80-100	65-100	36-80	22-40	7-20
55---------- Vernon	0-12	Clay----------	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	75-98	36-60	20-38
	12-31	Clay, silty clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	75-98	36-60	20-38
	31-75	Shaly clay, clay	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-100	65-96	30-60	15-38
56:* Volente---------	0-24	Clay loam--------	CH, MH	A-7-6	0	95-100	95-100	95-100	85-95	51-60	26-35
	24-38	Silty clay, clay loam, silty clay loam.	CH, CL	A-7-6	0	95-100	90-100	90-100	85-95	45-55	25-32
	38-42	Clay loam, silty clay loam, clay.	CL	A-6	0-7	90-100	80-100	80-100	75-90	30-40	13-23
	42-46	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Gageby----------	0-64	Clay loam--------	CL	A-4, A-6	0	100	95-100	85-100	51-90	25-40	8-24
57, 58---------- Woodward	0-31	Loam----------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	31-54	Weathered bedrock	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
1:*											
Acme	0-18	15-35	---	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.32	1	6	1-3
	18-30	---	---	---	---	---					
Cottonwood	0-8	18-35	---	0.6-2.0	0.11-0.18	7.9-8.4	Low	0.32	1	6	<1
	8-22	---	---	---	---	---					
2:*											
Burson	0-7	15-27	---	0.6-2.0	0.10-0.16	7.9-8.4	Low	0.43	1	---	<1
	7-36	---	---	---	---	---					
Quinlan	0-13	15-27	1.30-1.55	0.6-2.0	0.13-0.24	7.4-8.4	Low	0.32	2	4L	<1
	13-44	---	---	---	---	---					
3	0-7	6-18	---	2.0-6.0	0.10-0.15	6.1-7.3	Low	0.24	2	3	<1
Cobb	7-38	22-35	---	0.6-2.0	0.12-0.16	6.1-8.4	Low	0.32			
	38-42	---	---	---	---	---					
4,* 5:*											
Cobb	0-7	6-18	---	2.0-6.0	0.10-0.15	6.1-7.3	Low	0.24	2	3	<1
	7-38	22-35	---	0.6-2.0	0.12-0.16	6.1-8.4	Low	0.32			
	38-42	---	---	---	---	---					
Miles	0-10	7-18	---	2.0-6.0	0.10-0.15	6..-7.8	Low	0.24	5	3	<1
	10-63	20-35	---	0.6-2.0	0.12-0.18	6.6-8.4	Low	0.32			
6, 7	0-64	18-35	---	0.6-2.0	0.15-0.20	7.9-8.4	Low	0.32	5	5	<1
Colorado											
8	0-5	7-18	---	2.0-6.0	0.10-0.14	6.1-7.8	Very low	0.24	1	3	<1
Cosh	5-14	18-35	---	0.6-2.0	0.12-0.17	6.1-7.8	Low	0.32			
	14-24	---	---	---	---	---					
9	0-12	20-35	---	0.6-2.0	0.05-0.10	7.9-8.4	Very low	0.10	1	8	1-3
Ector	12-18	---	---	---	---	---					
10:*											
Ector	0-6	20-35	---	0.6-2.0	0.05-0.10	7.9-8.4	Very low	0.10	1	8	1-3
	6-18	---	---	---	---	---					
Rock outcrop.											
11, 12	0-64	18-35	---	0.6-2.0	0.16-0.20	7.9-8.4	Moderate	0.28	5	6	1-3
Gageby											
13, 14	0-16	35-50	---	0.2-0.6	0.15-0.20	7.9-8.4	High	0.32	1	4	1-3
Kavett	16-24	---	---	---	---	---					
15	0-8	40-60	---	<0.06	0.10-0.17	7.9-8.4	High	0.32	1	4	<1
Knoco	8-30	40-60	---	<0.06	0.-0.08	7.9-8.4	High				
16:*											
Latom	0-5	5-18	---	0.6-2.0	0.10-0.15	7.9-8.4	Low	0.24	1	3	.5-2
	5-12	---	---	---	---	---					
Rock outcrop.											
17:*											
Lozier	0-5	20-35	---	0.6-2.0	0.05-0.10	7.9-8.4	Very low	0.10	1	8	.5-3
	5-20	---	---	---	---	---					
Rock outcrop.											

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
18, 19----------	0-18	35-45	---	0.2-0.6	0.15-0.20	7.9-8.4	Moderate-----	0.32	1	6	1-3
Mereta	18-22	---	---	---	---	---	----------	0.32			
	22-40	---	---	---	---	---	----------	----			
20, 21----------	0-8	3-10	---	2.0-6.0	0.06-0.10	6.1-7.8	Low----------	0.20	5	2	<1
Miles	8-80	20-35	---	0.6-2.0	0.12-0.18	6.6-8.4	Low----------	0.32			
22, 23----------	0-10	7-18	---	2.0-6.0	0.10-0.15	6.1-7.8	Low----------	0.24	5	3	<1
Miles	10-63	20-35	---	0.6-2.0	0.12-0.18	6.6-8.4	Low----------	0.32			
24, 25----------	0-60	35-45	---	0.06-0.2	0.13-0.17	7.4-8.4	Moderate-----	0.32	5	4	1-3
Nipsum											
26, 27----------	0-7	8-27	---	0.6-2.0	0.15-0.20	6.6-7.8	Low----------	0.43	5	5	.5-1
Paducah	7-42	18-35	---	0.6-2.0	0.15-0.20	7.4-8.4	Low----------	0.37			
	42-54	10-27	---	0.6-2.0	0.10-0.18	7.9-8.4	Low----------	0.37			
28.*											
Pits											
29----------	0-6	10-35	---	0.6-2.0	0.10-0.15	7.9-8.4	Low----------	0.24	1	8	1-3
Pitzer	6-12	---	---	---	---	---	----------	----			
	12-54	---	---	---	---	---	----------	----			
30----------	0-5	18-25	---	0.6-2.0	0.10-0.16	7.9-8.4	Low----------	0.28	1	8	1-3
Potter	5-80	---	---	0.6-6.0	0.01-0.06	7.9-8.4	Low----------	----			
31----------	0-13	15-27	1.30-1.55	0.6-2.0	0.13-0.24	7.4-8.4	Low----------	0.32	2	4L	<1
Quinlan	13-44	---	---	---	---	---	----------	----			
32:*											
Quinlan---------	0-11	15-27	1.30-1.55	0.6-2.0	0.13-0.24	7.4-8.4	Low----------	0.32	2	4L	<1
	11-44	---	---	---	---	---	----------	----			
Burson----------	0-6	15-27	---	0.6-2.0	0.10-0.16	7.9-8.4	Low----------	0.43	1	---	<1
	6-36	---	---	---	---	---	----------	----			
Woodward--------	0-24	10-18	1.30-1.60	0.6-2.0	0.13-0.20	6.6-8.4	Low----------	0.37	3	5	1-3
	24-54	---	---	---	---	---	----------	----			
33----------	0-80	40-60	1.20-1.45	<0.06	0.12-0.18	7.4-8.4	High---------	0.32	5	4	.5-2
Randall											
34----------	0-45	40-60	---	<0.06	0.12-0.18	6.6-8.4	Very high----	0.32	5	4	1-3
Roscoe	45-75	40-60	---	<0.06	0.12-0.17	7.9-8.4	Very high----	0.32			
35, 36----------	0-9	20-35	---	0.6-2.0	0.15-0.20	7.4-8.4	Moderate-----	0.32	5	6	1-3
Rotan	9-50	35-45	---	0.2-0.6	0.14-0.18	7.4-8.4	Moderate-----	0.32			
	50-66	25-45	---	0.6-2.0	0.12-0.16	7.9-8.4	Moderate-----	0.32			
37, 38----------	0-12	35-45	---	0.2-0.6	0.15-0.20	7.9-8.4	Moderate-----	0.32	5	6	2-4
Rowena	12-38	35-50	1.45-1.50	0.2-0.6	0.14-0.18	7.9-8.4	High---------	0.32			
	38-69	35-50	---	0.2-0.6	0.11-0.15	7.9-8.4	High---------	0.32			
39, 40----------	0-10	20-35	---	0.6-2.0	0.15-0.20	6.6-7.8	Moderate-----	0.32	5	6	1-3
Sagerton	10-53	35-45	---	0.2-0.6	0.14-0.19	6.6-8.4	Moderate-----	0.32			
	53-68	35-45	---	0.2-0.6	0.10-0.17	7.9-8.4	Moderate-----	0.32			
41, 42----------	0-22	18-35	---	0.6-2.0	0.15-0.19	7.9-8.4	Low----------	0.28	5	5	1-3
Shep	22-60	18-35	---	0.6-2.0	0.13-0.17	7.9-8.4	Low----------	0.28			
43, 44----------	0-28	10-18	---	2.0-6.0	0.10-0.14	7.9-8.4	Low----------	0.24	2	3	1-3
Spade	28-48	---	---	---	---	---	----------	----			
45, 46----------	0-7	23-40	---	0.2-0.6	0.15-0.20	6.1-7.8	Moderate-----	0.32	1	6	1-3
Speck	7-18	35-60	---	0.06-0.2	0.12-0.18	6.1-7.8	High---------	0.32			
	18-20	---	---	---	---	---	----------	----			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
47----------	0-9	40-60	---	0.2-0.6	0.10-0.17	7.9-8.4	Moderate-----	0.20	1	8	2-7
Tarrant	9-13	---	---	---	---	---	----------	----			
48----------	0-17	15-20	1.30-1.55	0.6-2.0	0.15-0.20	6.6-7.8	Low----------	0.28	5	5	1-2
Texroy	17-72	20-32	1.40-1.70	0.6-2.0	0.15-0.20	6.6-8.4	Low----------	0.32			
49----------	0-11	27-35	---	0.2-0.6	0.15-0.20	6.6-8.4	High---------	0.32	5	6	1-2
Tillman	11-43	35-50	---	0.06-0.2	0.12-0.18	7.4-8.4	High---------	0.32			
	43-80	35-55	---	0.06-0.2	0.11-0.17	7.9-8.4	High---------	0.32			
50, 51----------	0-45	35-60	1.35-1.40	<0.06	0.12-0.18	7.4-8.4	Very high----	0.32	5	4	1-3
Tobosa	45-64	35-60	1.35-1.40	<0.06	0.10-0.18	7.9-8.4	High---------	0.32			
52, 53----------	0-25	40-55	---	0.2-0.6	0.15-0.20	7.9-8.4	High---------	0.32	2	4	1-5
Valera	25-27	---	---	---	---	---	----------	----			
	27-29	---	---	---	---	---	----------	----			
54----------	0-10	15-35	---	0.6-2.0	0.12-0.18	7.9-8.4	Low----------	0.28	4	4L	<1
Veal	10-18	20-35	---	0.6-2.0	0.10-0.18	7.9-8.4	Low----------	0.28			
	18-60	20-35	---	0.6-2.0	0.10-0.15	7.9-8.4	Low----------	0.28			
55----------	0-12	40-60	1.35-1.55	<0.06	0.10-0.17	7.9-8.4	High---------	0.32	2	4	.5-1
Vernon	12-31	40-60	1.30-1.60	<0.06	0.10-0.15	7.9-8.4	High---------	0.32			
	31-75	40-60	1.30-1.60	<0.06	0.-0.10	7.9-8.4	High---------	0.32			
56:*											
Volente---------	0-24	35-50	---	0.2-0.6	0.15-0.20	7.9-8.4	High---------	0.32	5	6	2-7
	24-38	35-50	---	0.2-0.6	0.15-0.20	7.9-8.4	High---------	0.32			
	38-42	35-50	---	0.6-2.0	0.13-0.20	7.9-8.4	Moderate-----	0.32			
Gageby----------	0-64	18-35	---	0.6-2.0	0.16-0.20	7.9-8.4	Moderate-----	0.28	5	6	1-3
57, 58----------	0-31	10-18	1.30-1.60	0.6-2.0	0.13-0.20	6.6-8.4	Low----------	0.37	3	5	1-3
Woodward	31-54	---	---	---	---	---	----------	----			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Depth	Hardness	Uncoated steel	Concrete
					Ft			In		In			
1:*													
Acme	C	None	---	---	>6.0	---	---	10-20	Soft	---	---	High	Moderate.
Cottonwood	C	None	---	---	>6.0	---	---	3-12	Soft	---	---	High	Moderate.
2:*													
Burson	C	None	---	---	>6.0	---	---	3-12	Soft	---	---	Low	Low.
Quinlan	C	None	---	---	>6.0	---	---	10-20	Soft	---	---	Moderate	Low.
3---- Cobb	B	None	---	---	>6.0	---	---	20-40	Soft	---	---	Moderate	Low.
4,* 5:*													
Cobb	B	None	---	---	>6.0	---	---	20-40	Soft	---	---	Moderate	Low.
Miles	B	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
6---- Colorado	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	---	---	High	Low.
7---- Colorado	B	Frequent	Very brief	Apr-Oct	>6.0	---	---	>60	---	---	---	High	Low.
8---- Cosh	C	None	---	---	>6.0	---	---	12-20	Soft	---	---	Low	Low.
9---- Ector	D	None	---	---	>6.0	---	---	4-20	Hard	---	---	High	Low.
10:*													
Ector	D	None	---	---	>6.0	---	---	4-20	Hard	---	---	High	Low.
Rock outcrop.													
11---- Gageby	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	---	---	Moderate	Low.
12---- Gageby	B	Frequent	Very brief	Apr-Oct	>6.0	---	---	>60	---	---	---	Moderate	Low.
13, 14---- Kavett	D	None	---	---	>6.0	---	---	10-20	Hard	10-20	Thick	High	Low.
15---- Knoco	D	None	---	---	>6.0	---	---	3-12	Soft	---	---	High	Low.
16:*													
Latom	D	None	---	---	>6.0	---	---	4-14	Soft	---	---	Low	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Depth	Hardness	Uncoated steel	Concrete
					Ft			In		In			
16:* Rock outcrop.													
17:* Lozier	D	None	---	---	>6.0	---	---	4-16	Hard	---	---	High	Low.
Rock outcrop.													
18, 19---- Mereta	C	None	---	---	>6.0	---	---	>60	---	14-20	Thin	High	Low.
20, 21, 22, 23---- Miles	B	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
24, 25---- Nipsum	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
26, 27---- Paducah	B	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
28.* Pits													
29---- Pitzer	C	None	---	---	>6.0	---	---	>60	---	4-14	Thin	Low	Low.
30---- Potter	C	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
31---- Quinlan	C	None	---	---	>6.0	---	---	10-20	Soft	---	---	Moderate	Low.
32:* Quinlan	C	None	---	---	>6.0	---	---	10-20	Soft	---	---	Moderate	Low.
Burson	C	None	---	---	>6.0	---	---	3-12	Soft	---	---	Low	Low.
Woodward	B	None	---	---	>6.0	---	---	20-40	Soft	---	---	Low	Low.
33---- Randall	D	None	---	---	+1-6.0	Perched	May-Nov	>60	---	---	---	High	Low.
34---- Roscoe	D	None	---	---	+1-6.0	Perched	May-Sep	>60	---	---	---	High	Low.
35, 36---- Rotan	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
37, 38---- Rowena	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
39, 40---- Sagerton	C	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Depth	Hardness	Uncoated steel	Concrete
					Ft			In		In			
41, 42--Shep	B	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
43, 44--Spade	B	None	---	---	>6.0	---	---	20-40	Soft	---	---	Low	Low.
45, 46--Speck	D	None	---	---	>6.0	---	---	14-20	Hard	---	---	High	Low.
47--Tarrant	D	None	---	---	>6.0	---	---	6-20	Hard	---	---	High	Low.
48--Texroy	B	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
49--Tillman	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
50, 51--Tobosa	D	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
52, 53--Valera	C	None	---	---	>6.0	---	---	20-40	Hard	20-40	Thick	High	Low.
54--Veal	B	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
55--Vernon	D	None	---	---	>6.0	---	---	20-36	Soft	---	---	High	Low.
56:*													
Volente	C	None	---	---	>6.0	---	---	34-50	Hard	---	---	High	Low.
Gageby	B	Frequent	Very brief	Apr-Oct	>6.0	---	---	>60	---	---	---	Moderate	Low.
57, 58--Woodward	B	None	---	---	>6.0	---	---	20-40	Soft	---	---	Low	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--ENGINEERING TEST DATA

[Dashes indicate data were not available. NP means nonplastic]

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution[1]										Liquid limit[2]	Plasticity index[2]	Particle density	Shrinkage		
			Percentage passing sieve--							Percentage smaller than--								
	AASHTO	Unified	7/4 inch	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
													Pct		G/cc	Pct	Pct	Pct
Cobb fine sandy loam:[3] (S77TX-353-010)																		
Ap------- 0 to 7	A-4 (00)	SC	100	100	100	99	97	94	40	33	19	16	21	8	2.67	15.0	3.7	1.8
B21t----- 7 to 16	A-6 (08)	CL	100	100	100	99	96	93	57	54	35	31	35	21	2.68	12.0	11.6	1.9
B22t-----16 to 38	A-6 (09)	CL	100	100	98	94	90	85	56	53	32	29	36	22	2.68	12.0	11.7	1.9
Cr-------38 to 42	A-6 (05)	CL	100	98	94	88	82	76	53	49	30	23	29	17	2.69	13.0	8.8	1.9
Cottonwood loam:[4] (S77TX-353-008)																		
A1------- 0 to 8	A-6 (06)	CL	100	100	99	99	97	95	66	58	27	20	29	13	2.68	16.0	7.2	1.8
C1------ 8 to 16	A-2-4(00)	SM	100	90	89	86	81	64	24	22	9	8	30	4	2.84	26.0	2.3	1.6
Ector very gravelly clay loam:[5] (S77TX-353-004)																		
A1------- 0 to 6	A-7-6(05)	GC	100	66	64	60	58	55	46	41	17	12	42	20	2.60	20.0	10.0	1.7
Gageby clay loam:[6] (S77TX-353-017)																		
Ap------- 0 to 8	A-6 (07)	CL	100	100	100	100	100	99	74	62	26	18	27	13	2.66	15.0	6.3	1.8
A12------ 8 to 22	A-6 (11)	CL	100	100	100	100	100	99	73	64	31	24	32	18	2.65	14.0	9.5	1.9
B21------22 to 44	A-6 (07)	CL	100	100	99	98	97	94	61	55	28	23	29	16	2.69	14.0	7.8	1.9
B22------44 to 64	A-6 (17)	CL	100	99	97	95	93	91	78	71	45	36	40	23	2.69	14.0	12.7	1.9
IIC------64 to 77	A-6 (11)	CL	100	100	100	100	99	98	81	71	32	23	32	16	2.68	15.0	8.8	1.8
Kavett clay:[7] (S77TX-353-005)																		
A11------ 0 to 7	A-7-6(28)	CL-CH or CL	100	100	100	99	99	99	89	82	41	32	50	30	2.66	15.0	14.8	1.8
A12------ 7 to 16	A-7-6(27)	CH	100	100	98	94	92	90	83	77	49	40	52	31	2.66	14.0	16.4	1.9

See footnotes at end of table.

TABLE 19.--ENGINEERING TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution[1]										Liquid limit[2]	Plasticity index[2]	Particle density	Shrinkage		
			Percentage passing sieve--							Percentage smaller than--								
	AASHTO	Unified	7/4 inch	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
													Pct		G/cc	Pct	Pct	Pct
Quinlan loam:[8] (S77TX-353-019)																		
A1------- 0 to 6	A-4 (02)	CL-ML	100	100	100	99	97	97	58	42	17	15	26	7	2.67	18.0	4.3	1.7
C1------13 to 44	A-4 (00)	SM-SC	100	100	97	92	91	90	46	30	9	7	26	6	2.65	20.0	3.2	1.6
Roscoe clay:[9] (S77TX-353-001)																		
Ap------- 0 to 7	A-7-6(25)	CL	100	100	100	100	100	99	87	81	50	41	48	28	2.67	14.0	15.3	1.9
A11------ 7 to 14	A-7-6(27)	CL-CH or CH	100	100	100	100	100	99	85	78	50	42	50	31	2.68	14.0	16.0	1.9
A12------14 to 30	A-7-6(35)	CH	100	100	100	100	98	96	87	82	56	51	58	38	2.71	14.0	18.8	1.9
C1ca-----45 to 60	A-7-6(30)	CH	100	100	100	100	100	99	85	78	52	47	52	35	2.72	11.0	18.0	2.0
Rowena clay loam:[10] (S77TX-353-012)																		
A-------- 0 to 12	A-6 (14)	CL	100	100	100	100	100	99	77	66	34	27	37	20	2.67	16.0	10.0	1.8
B21------12 to 28	A-7-6(22)	CL	100	100	100	100	100	100	82	74	43	34	44	27	2.68	13.0	14.5	1.9
B22------28 to 38	A-7-6(28)	CL	100	100	100	99	99	98	86	79	49	43	49	32	2.69	13.0	16.7	2.0
C1ca-----38 to 55	A-6 (09)	CL	100	98	96	93	91	86	74	71	54	42	32	14	2.69	19.0	6.7	1.7
Tarrant stony clay:[11] (S77TX-353-002)																		
A11------ 0 to 9	A-7-6(29)	CH	100	100	100	100	100	99	87	83	45	37	52	32	2.62	15.0	15.6	1.8
Texroy loam:[12] (S77TX-353-007)																		
Ap------- 0 to 8	A-6 (16)	CL	100	100	100	100	100	100	84	78	34	22	39	19	2.63	16.0	10.9	1.7
B1------- 8 to 17	A-6 (08)	CL	100	100	100	100	100	99	63	57	30	23	31	17	2.66	13.0	9.3	1.9
B22t-----24 to 34	A-6 (11)	CL	100	100	100	100	100	99	69	65	37	28	34	19	2.68	14.0	9.8	1.8
IIB3-----54 to 72	A-4 (00)	SM-SC	100	100	100	100	100	99	48	39	18	14	22	6	2.68	16.0	3.6	1.8

See footnotes at end of table.

TABLE 19.--ENGINEERING TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution[1]									Liquid limit[2]	Plasticity index[2]	Particle density	Shrinkage		
			Percentage passing sieve--							Percentage smaller than--							
	AASHTO	Unified	7/4 inch	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
													Pct		g/cc	Pct	Pct	Pct
Tillman clay loam:[13] (S77TX-353-009)																		
A1------- 0 to 11	A-6 (11)	CL	100	100	100	100	100	100	76	68	38	32	31	17	2.68	14.0	8.8	1.9
B21t-----11 to 24	A-6 (18)	CL	100	100	100	99	98	96	77	70	47	39	40	25	2.71	12.0	14.0	2.0
B24tca---43 to 62	A-6 (14)	CL	100	100	99	98	96	94	81	75	48	37	34	20	2.73	13.0	11.3	1.9
B3-------62 to 80	A-6 (11)	CL	100	100	100	100	100	97	75	66	38	32	30	18	2.72	12.0	9.5	1.9
Vernon clay:[14] (S77TX-353-013)																		
A1------- 0 to 12	A-6 (13)	CL	100	100	99	99	99	99	75	65	41	36	36	20	2.71	14.0	11.0	1.9
B2-------12 to 31	A-6 (18)	CL	100	100	98	97	95	93	83	75	47	39	39	23	2.75	12.0	13.3	2.0
Cr-------31 to 75	A-6 (11)	CL	100	100	98	95	92	88	77	69	41	30	36	16	2.81	15.0	10.4	1.9
Woodward loam:[15] (S77TX-353-014)																		
A1------- 0 to 8	A-4 (02)	CL	100	100	100	100	100	100	56	42	20	18	26	9	2.64	19.0	4.3	1.7
B2------- 8 to 31	A-4 (05)	CL	100	100	100	100	100	100	70	52	18	15	28	10	2.66	18.0	5.3	1.7
Cr-------31 to 54	A-4 (06)	CL	100	100	100	100	100	100	77	62	14	11	29	10	2.68	19.0	5.0	1.7

[1]For soil materials larger than 3/8 inch, square mesh wire sieves were used that are slightly larger than equivalent round sieves, but these differences do not seriously affect the data.

[2]Liquid limit and plastic index values were determined by the AASHTO-89 and AASHTO-90 methods except that soil was added to water.

[3]Cobb fine sandy loam:
2.0 miles east on Farm Road 2319 in Champion, 2.0 miles south on gravel road, 300 feet southeast.

[4]Cottonwood loam:
8 miles east of Sweetwater on I-20, 2 miles south on gravel road, 100 feet west.

[5]Ector very gravelly clay loam:
7.0 miles east of school at Nolan, 1.25 miles south on gravel road, 100 feet west.

[6]Gageby clay loam:
4.25 miles west of Nolan and Taylor county line on I-20, 0.75 mile north on gravel road, 500 feet west.

[7]Kavett clay:
7.0 miles east of school at Nolan on Farm Road 126, 3.3 miles south on gravel road, 100 feet east in rangeland.

[8]Quinlan loam:
From I-20 4.0 miles south on Farm Road 1856, 1.0 mile east, 0.25 mile south on trail, 200 feet east in field.

[9]Roscoe clay:
1.1 miles west of junction I-20 and U.S. Highway 80 west of Sweetwater, 0.5 miles north on gravel road, 200 feet west.

[10]Rowena clay loam:
6.0 miles west of intersection of I-20 and Farm Road 608 in Roscoe, 2.0 miles north, 0.5 miles east, 200 feet south.

[11]Tarrant stony clay:
5.5 miles west of Nolan and Taylor county line on I-20, about 4.0 miles south in rangeland.

[12]Texroy loam:
From intersection with U.S. Highway 80, 2.0 miles north on Farm Road 419, 0.25 miles east, 200 feet south.

[13]Tillman clay loam:
6.0 miles east of Sweetwater on I-20, 1.0 mile north on field road, 100 feet east.

[14]Vernon clay:
6.0 miles east of Sweetwater on I-20, 1.7 miles north on oil field road, 50 feet west.

[15]Woodward loam:
2.25 miles north of Sweetwater on Texas Highway 70, 0.6 mile east, 50 feet north.

TABLE 20.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
*Acme	Loamy, mixed, thermic, shallow Entic Haplustolls
*Burson	Loamy, mixed (calcareous), thermic, shallow Ustic Torriorthents
Cobb	Fine-loamy, mixed, thermic Udic Haplustalfs
Colorado	Fine-loamy, mixed (calcareous), thermic Typic Ustifluvents
Cosh	Loamy, mixed, thermic, shallow Udic Rhodustalfs
Cottonwood	Loamy, mixed (calcareous), thermic, shallow Ustic Torriorthents
Ector	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls
*Gageby	Fine-loamy, mixed, thermic Cumulic Haplustolls
Kavett	Clayey, montmorillonitic, thermic, shallow Petrocalcic Calciustolls
Knoco	Clayey, mixed (calcareous), thermic, shallow Ustic Torriorthents
Latom	Loamy, mixed (calcareous), thermic Lithic Ustic Torriorthents
Lozier	Loamy-skeletal, carbonatic, thermic Lithic Calciorthids
Mereta	Clayey, mixed, thermic, shallow Petrocalcic Calciustolls
*Miles	Fine-loamy, mixed, thermic Udic Paleustalfs
Nipsum	Fine, mixed, thermic Cumulic Haplustolls
*Paducah	Fine-silty, mixed, thermic Typic Haplustalfs
Pitzer	Loamy, mixed, thermic, shallow Petrocalcic Calciustolls
*Potter	Loamy, carbonatic, thermic, shallow Ustollic Calciorthids
Quinlan	Loamy, mixed, thermic, shallow Typic Ustochrepts
Randall	Fine, montmorillonitic, thermic Udic Pellusterts
Roscoe	Fine, montmorillonitic, thermic Typic Pellusterts
Rotan	Fine, mixed, thermic Pachic Paleustolls
Rowena	Fine, mixed, thermic Vertic Calciustolls
*Sagerton	Fine, mixed, thermic Typic Paleustolls
Shep	Fine-loamy, mixed, thermic Typic Ustochrepts
Spade	Coarse-loamy, mixed, thermic Aridic Ustochrepts
Speck	Clayey, mixed, thermic Lithic Argiustolls
Tarrant	Clayey-skeletal, montmorillonitic, thermic Lithic Calciustolls
Texroy	Fine-loamy, mixed, thermic Pachic Argiustolls
Tillman	Fine, mixed, thermic Typic Paleustolls
Tobosa	Fine, montmorillonitic, thermic Typic Chromusterts
Valera	Fine, montmorillonitic, thermic Petrocalcic Calciustolls
Veal	Fine-loamy, carbonatic, thermic Aridic Ustochrepts
Vernon	Fine, mixed, thermic Typic Ustochrepts
*Volente	Fine, mixed, thermic Pachic Haplustolls
Woodward	Coarse-silty, mixed, thermic Typic Ustochrepts

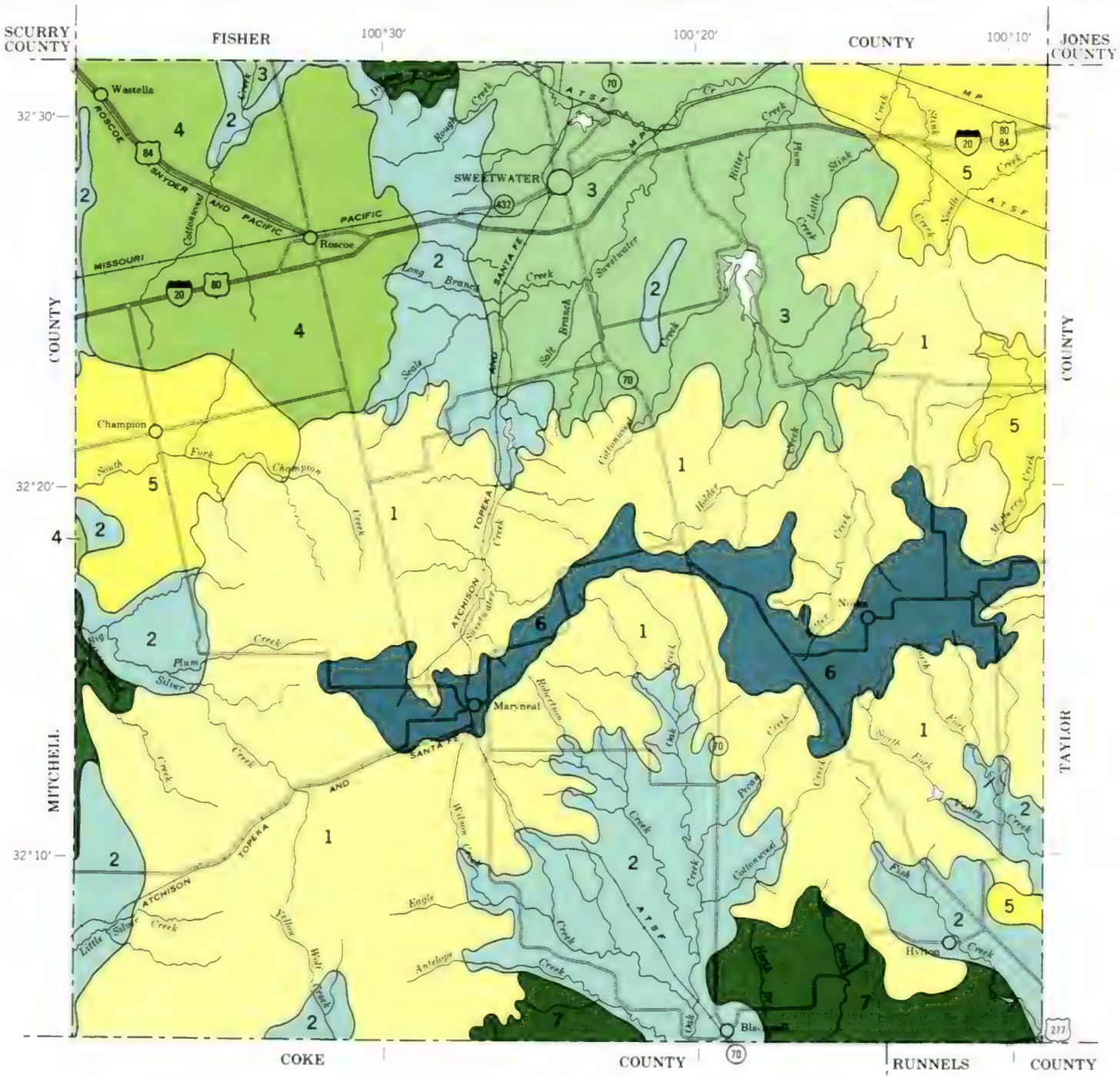
* The soil is a taxadjunct to the series. See text for description of those characteristics of the soil that are outside the range of the series.

* U.S. GOVERNMENT PRINTING OFFICE: 1981 -344-860/1031

NRCS Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.



LEGEND

1 ECTOR: Very shallow and shallow, undulating to hilly, moderately permeable, loamy and very gravelly soils

2 POTTER-VEAL-MERETA: Very shallow, shallow, and deep, nearly level to hilly, moderately permeable to moderately slowly permeable, loamy and gravelly soils

3 WOODWARD-QUINLAN-BURSON: Very shallow to moderately deep, gently sloping to hilly, moderately permeable, loamy soils

4 ROWENA: Deep, nearly level to gently sloping, moderately slowly permeable, loamy soils

5 SAGERTON-ROTAN-COBB: Deep and moderately deep, nearly level to gently sloping, moderately permeable to moderately slowly permeable, loamy soils

6 TOBOSA-KAVETT: Deep and shallow, nearly level to gently sloping, very slowly permeable and moderately slowly permeable, clayey soils

7 LATOM-COBB-ROCK OUTCROP: Very shallow to moderately deep, nearly level to rolling, moderately permeable, loamy soils and rock outcrop

Compiled 1980

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

N

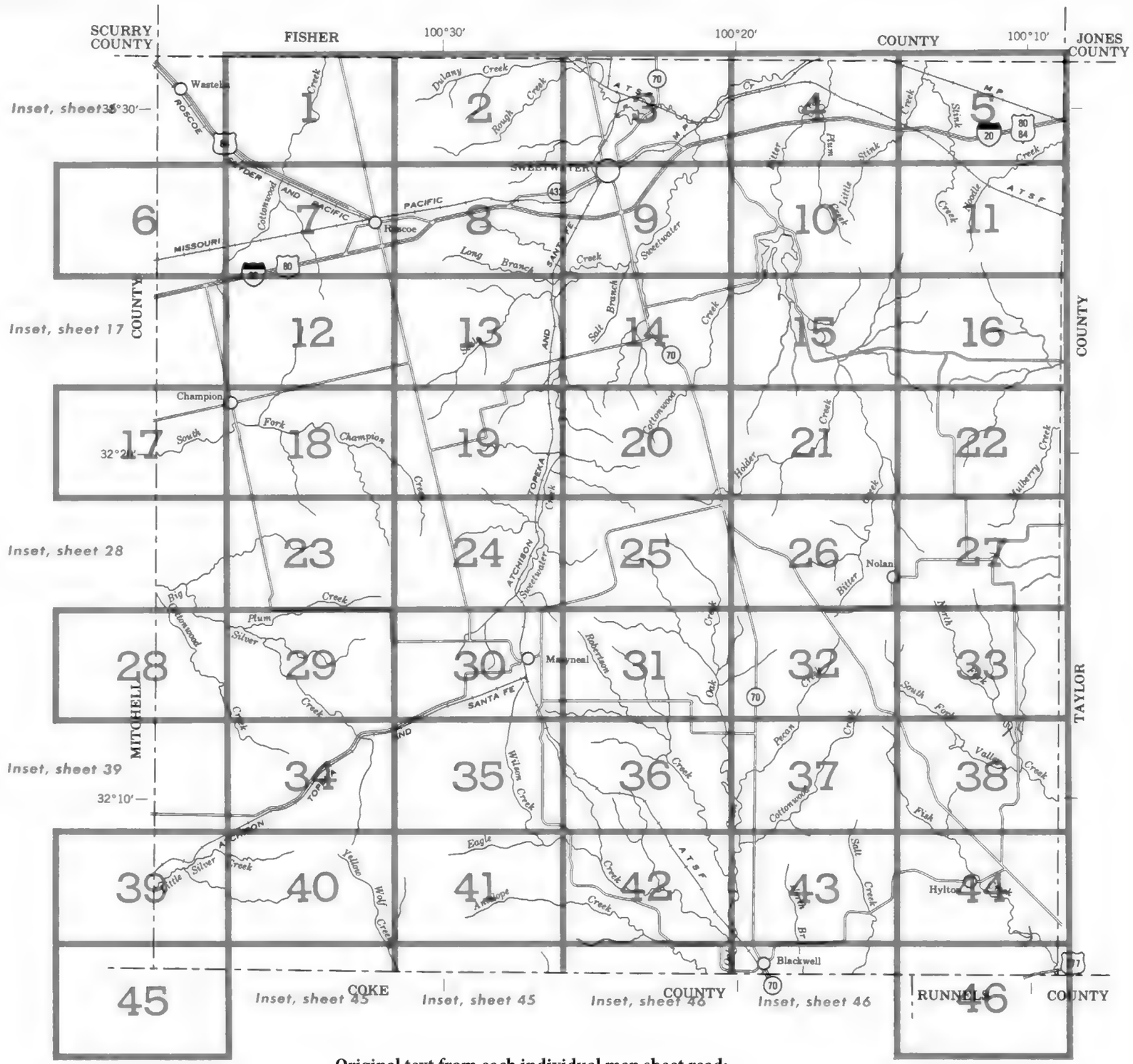
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
NOLAN COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km



Original text from each individual map sheet read:
This map is compiled on 1976 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and Cooperating Agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

INDEX TO MAP SHEETS
NOLAN COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate (21)
- Federal (173)
- State (28)
- County, farm or ranch (1283)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (Gas)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water, w)
- Intermittent (int, i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (CnB, WaC2)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown) (S)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

SOIL LEGEND

The soil legend is numeric. Most units in the legend are narrowly defined. Soil names followed by the superscript 1/ are broadly defined units. The composition of these units is more variable than that of other units in the survey area, but mapping has been controlled well enough to be interpreted for the expected use of the soils.

SYMBOL	NAME
1	Acme-Cottonwood complex, 1 to 5 percent slopes
2	Burson-Quinlan association, hilly 1/
3	Cobb fine sandy loam, 1 to 5 percent slopes
4	Cobb-Miles complex, 0 to 1 percent slopes
5	Cobb-Miles complex, 1 to 3 percent slopes
6	Colorado loam, occasionally flooded
7	Colorado loam, frequently flooded
8	Cosh fine sandy loam, 1 to 5 percent slopes
9	Ector very gravelly clay loam, 1 to 8 percent slopes
10	Ector-Rock outcrop association, hilly 1/
11	Gageby clay loam, occasionally flooded
12	Gageby clay loam, frequently flooded
13	Kavett clay, 0 to 1 percent slopes
14	Kavett clay, 1 to 3 percent slopes
15	Knoco clay, 1 to 8 percent slopes
16	Latom-Rock outcrop association, rolling 1/
17	Lozier-Rock outcrop association, steep 1/
18	Mereta clay loam, 0 to 1 percent slopes
19	Mereta clay loam, 1 to 3 percent slopes
20	Miles loamy fine sand, 0 to 3 percent slopes
21	Miles loamy fine sand, 3 to 5 percent slopes
22	Miles fine sandy loam, 1 to 3 percent slopes
23	Miles fine sandy loam, 3 to 5 percent slopes
24	Nipsum clay loam, 0 to 1 percent slopes
25	Nipsum clay loam, 1 to 3 percent slopes
26	Paducah loam, 1 to 3 percent slopes
27	Paducah loam, 3 to 5 percent slopes
28	Pits
29	Pitzer gravelly loam, 1 to 8 percent slopes
30	Potter gravelly loam, 1 to 20 percent slopes
31	Quinlan loam, 1 to 5 percent slopes
32	Quinlan-Burson-Woodward association, rolling 1/
33	Randall clay
34	Roscoe clay
35	Rotan clay loam, 0 to 1 percent slopes
36	Rotan clay loam, 1 to 3 percent slopes
37	Rowena clay loam, 0 to 1 percent slopes
38	Rowena clay loam, 1 to 3 percent slopes
39	Sagerton clay loam, 0 to 1 percent slopes
40	Sagerton clay loam, 1 to 3 percent slopes
41	Shep loam, 1 to 5 percent slopes
42	Shep loam, 5 to 12 percent slopes
43	Spade loam, 1 to 3 percent slopes
44	Spade loam, 3 to 5 percent slopes
45	Speck clay loam, 0 to 1 percent slopes
46	Speck clay loam, 1 to 3 percent slopes
47	Terrant stony clay, 1 to 8 percent slopes
48	Texroy loam, 0 to 1 percent slopes
49	Tillman clay loam, 0 to 1 percent slopes
50	Tobosa clay, 0 to 1 percent slopes
51	Tobosa clay, 1 to 3 percent slopes
52	Valera silty clay, 0 to 1 percent slopes
53	Valera silty clay, 1 to 3 percent slopes
54	Veal loam, 1 to 5 percent slopes
55	Vernon clay, 1 to 3 percent slopes
56	Volente-Gageby complex, 0 to 5 percent slopes
57	Woodward loam, 1 to 3 percent slopes
58	Woodward loam, 3 to 5 percent slopes

NOLAN COUNTY, TEXAS — SHEET NUMBER 1

1 040 000 FEET

FISHER COUNTY

(Joins inset, sheet 6)

(Joins sheet 2)

(Joins sheet 7)

1 065 000 FEET

Cottonwood

Cottonwood

Cottonwood

GORDON — SNYDER — AND — PACIFIC

84

608

N

2 Miles

10 000 Feet

1

5 000

0

Scale 1:24 000

NOLAN COUNTY, TEXAS — SHEET NUMBER 2

2

N

2 Miles 10000 Feet

1 5000

Scale 1:24000

5000 4000 3000 2000 1000 0

(Joins sheet 1)

1,095,000 FEET

FISHER COUNTY

Duluney Creek

Rough Creek

Wolf Hollow

Airport

Airport

310,000 FEET

(Joins sheet 8) 1,070,000 FEET

(Joins sheet 3)

NOLAN COUNTY, TEXAS — SHEET NUMBER 3

3

N

2 Miles

10000 Feet

Scale 1:24000

1 125 000 FEET

NOLAN COUNTY, TEXAS — SHEET NUMBER 4

4

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

1 1/4 1/2 3/4 1

1,155,000 FEET

32,000 FEET

FISHER COUNTY

Sweetwater Creek

Bitter Creek

PACIFIC AND SANTA FE

TEXAS TOPEKA AND SANTA FE

ATCHISON TOPEKA AND SANTA FE

Bitter Creek

Hunt Creek

Stink Creek

Little Creek

(Joins sheet 3)

(Joins sheet 5)

(Joins sheet 10)

1,130,000 FEET

NOLAN COUNTY, TEXAS — SHEET NUMBER 5

5

N

FISHER COUNTY

JONES CO

TAYLOR COUNTY

(Joins sheet 4)

(Joins sheet 11)

1 320 000 FEET

1 180 000 FEET

Texas and Pacific

Atchison Topeka and Santa Fe

Slink Creek

Little Slink Creek

Nuvalde Creek

2 Miles

10 000 Feet

Scale 1:24000

6

N

2 Miles
10000 Feet
1
5000
Scale 1:24000
5000 4000 3000 2000 1000 0 0

1 035 000 FEET

FISHER COUNTY

Wastella

ROSCOE SNYDER

ANG PACIFIC

MITCHELL COUNTY

1 025 000 FEET

(Joins upper right)

(Joins sheet 1)

(Joins lower left)

1 035 000 FEET

MITCHELL COUNTY

TEXAS PACIFIC ANG

Cottonwood Creek

1 025 000 FEET

(Joins inset, sheet 17)

(Joins sheet 7)

NOLAN COUNTY, TEXAS — SHEET NUMBER 7

7

N

1 040 000 FEET

(Joins sheet 1)

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 12)

1 065 000 FEET

Cottonwood Creek

ROSCOE SNYDER AND PACIFIC TEXAS

ROSCOE

2 Miles

10 000 Feet

Scale 1 : 24 000

NOLAN COUNTY, TEXAS — SHEET NUMBER 8

8

N

(Joins sheet 2)

(Joins sheet 7)

(Joins sheet 13)

(Joins sheet 9)

1 295 000 FEET

305 000 FEET

200 000 FEET

Sweetwater Municipal Airport

Bell Springs

Idlewild

Inkman Spring

Oak Spring

Long Branch

ROSCOE

TEXAS PACIFIC

Scale 1:24 000

2 Miles 10 000 Feet 5 000 0 1000 2000 3000 4000 5000


SWEETWATER
(county seat)
Sweetwater Creek
Town Creek
Sweetwater Creek
Long Branch Creek
PACIFIC
TEXAS
SANTA FE
ATCHISON
TOPEKA
AND
(Joins sheet 3)
(Joins sheet 8)
(Joins sheet 10)
(Joins sheet 14)
1 125 000 FEET
2 Miles
10000 Feet
5000
Scale 1:24000

NOLAN COUNTY, TEXAS — SHEET NUMBER 10

10

N

(Joins sheet 4)

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 15)

1 155 000 FEET

1 125 000 FEET

2 Miles

10000 Feet

Scale 1:24000

Bitter Creek

Beacon Hill

Piper Creek

Little Stink Creek

Point Gainey

Lake Sweetwater

Firemans Point

Cottonwood Creek

Outlaw Canyon

Dug Spring Canyon

Dug Spring

BNSF

NOLAN COUNTY, TEXAS — SHEET NUMBER 11

1 155 000 FEET

(Joins sheet 5)

(Joins sheet 10)

(Joins sheet 16)

1 180 000 FEET

Stink Creek

Stink Creek

Stink Creek

Trouble Creek

ATCHISON TOPEKA AND SANTA FE

TAYLOR COUNTY

11

N

2 Miles

10000 Feet

Scale 1:24000

NOLAN COUNTY, TEXAS — SHEET NUMBER 12

12

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

(Joins sheet 7)

1 065 000 FEET

285 000 FEET

(Joins inset, sheet 17)

(Joins sheet 13)

(Joins sheet 18)

1 040 000 FEET

(13)

N

(Joins sheet 8)

(Joins sheet 12)

(Joins sheet 14)

(Joins sheet 19)

Prong Creek

Finn Creek

Sweetwater Creek

Shaufler

Sealey Creek

Finn Creek

SANTA FE

ATCHISON TOPEKA

608

2319

2 Miles

10000 Feet

Scale 1:24000

5000

14

N

Scale 1:24000

2 Miles 1 0 1 ½ 0 ½ 1

10000 Feet 5000 0 1000 2000 3000 4000 5000

(Joins sheet 9)

(Joins sheet 13)

(Joins sheet 15)

(Joins sheet 20)

1 125 000 FEET

1 093 500 FEET

Lone Branch

Creek

Sweetwater

Soil Branch

Cottonwood Community

Cottonwood Creek

1856

1809

1859

70

1 125 000 FEET

285 000 FEET

(Joins sheet 10)

(Joins sheet 14)

(Joins sheet 16)

(Joins sheet 21)

Cottonwood Creek

Lake Sweetwater

Bitter 12 Creek

Cottonwood Mountain

Holliday Creek

Bitter Creek

Paige Flat

Dill Canyon

Little Blue

Gainey Point

1856

2035

15

N

2 Miles

1

10000 Feet

5000

Scale 1:24000

0

1000

2000

3000

4000

5000

NOLAN COUNTY, TEXAS — SHEET NUMBER 16

16

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0

1000

2000

3000

4000

5000

(Joins sheet 11)

(Joins sheet 15)

(Joins sheet 22)

1 180 000 FEET

280 000 FEET

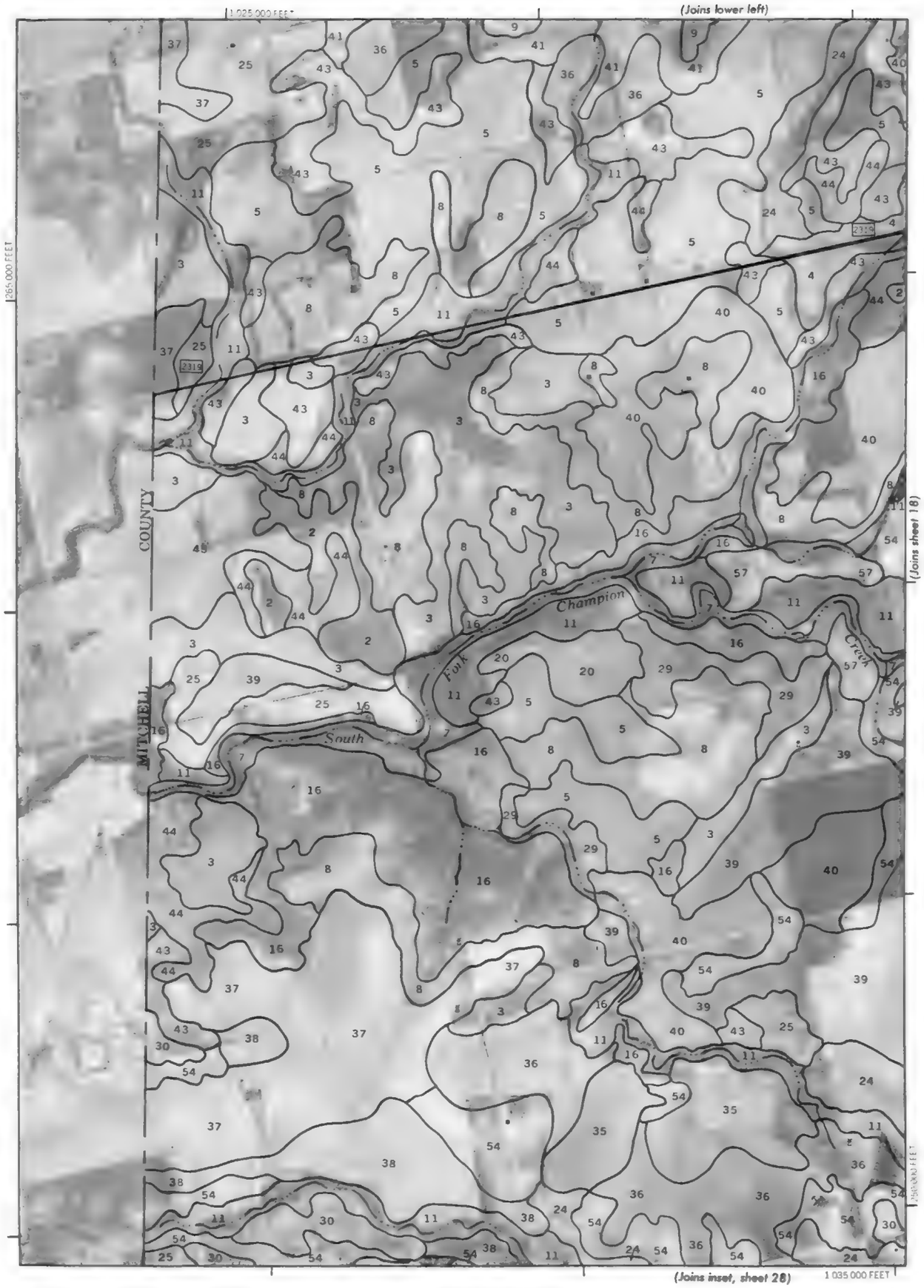
COUNTY

TAYLOR

2035

Weaver Springs Creek

Black Point



17

N

2 Miles

10000 Feet

Scale 1:24000

18

N

Scale 1:24000

2 Miles 10000 Feet

1 5000

(Joins sheet 12)

(Joins sheet 17)

(Joins sheet 23)

(Joins sheet 19)

Champion

Champion Creek

South Fork

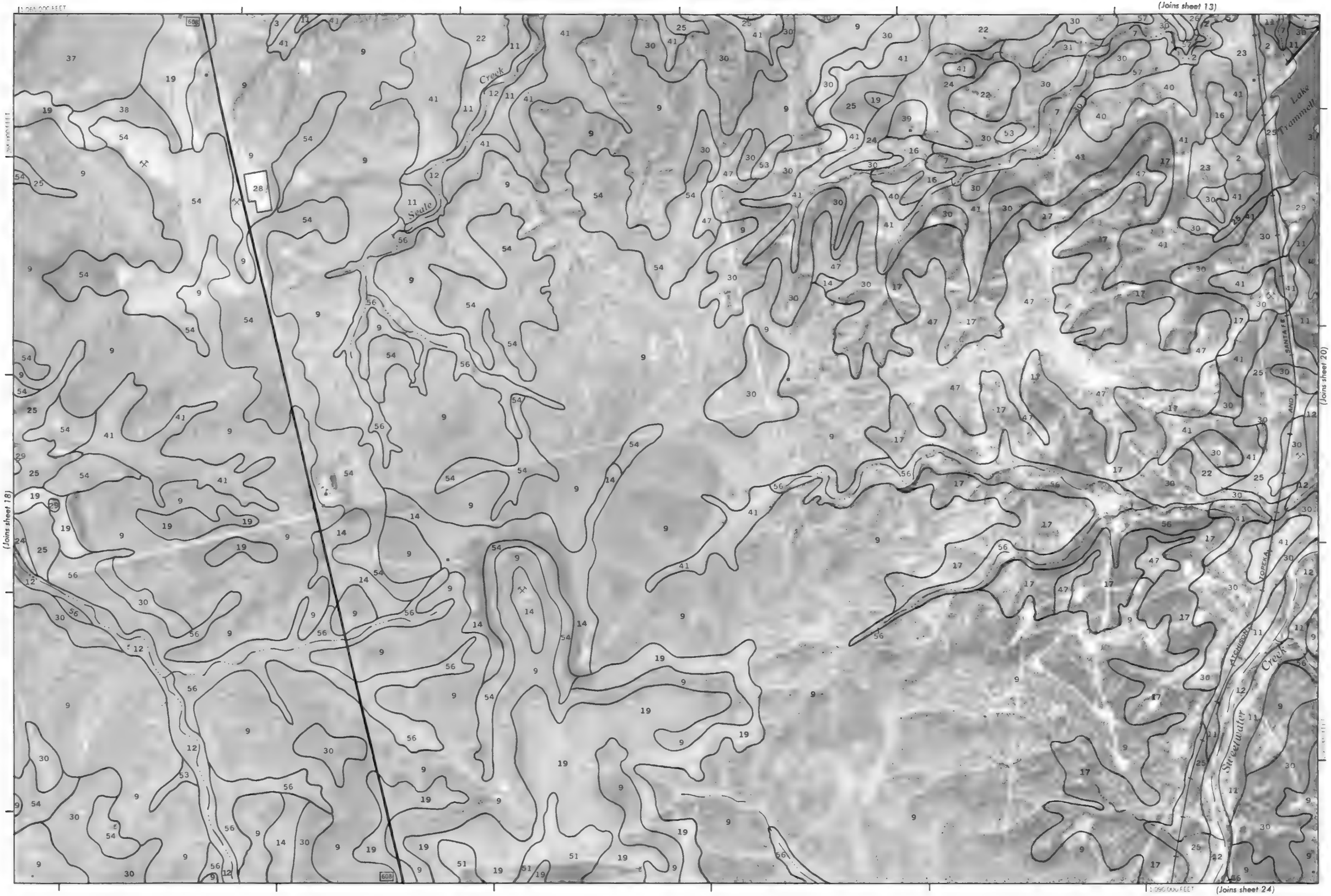
South Fork

Champion Creek

1230

2319

NOLAN COUNTY, TEXAS — SHEET NUMBER 19



19

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

NOLAN COUNTY, TEXAS — SHEET NUMBER 20

20

N

(Joins sheet 14)

(Joins sheet 19)

Lake Trammell

Wildcat Mountain

Ninemile Hill

Cottonwood Creek

Spring Creek

Hoodoo Draw

(Joins sheet 21)

1 095 000 FEET (Joins sheet 25)

Scale 1:24000

2 Miles 1 0 ¼ ½ ¾ 1

10000 Feet 5000 0 1000 2000 3000 4000 5000

NOLAN COUNTY, TEXAS — SHEET NUMBER 21

1 125 000 FEET

(Joins sheet 15)

(Joins sheet 20)

(Joins sheet 22)

(Joins sheet 26)

Paige Flat

Little Blue

Gainey Points

Merry Point

Robtann Draw

Bitter Creek

Holder Creek

Roodod Draw

Holder Creek

21

N

2 Miles

10000 Feet

Scale 1:24000

NOLAN COUNTY, TEXAS — SHEET NUMBER 22

22

N

(Joins sheet 16)

(Joins sheet 21)

(Joins sheet 27)

Black Point

Ringtop

Mulberry Creek

TAYLOR COUNTY

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

NOLAN COUNTY, TEXAS -- SHEET NUMBER 23

23

N

(Joins sheet 18)

(Joins sheet 28)

(Joins sheet 24)

(Joins sheet 29)

Barnett Creek

Burnett Creek

Bench Mountain

South Champion Creek

Plum Creek

2 Miles

10000 Feet

Scale 1:24000

NOLAN COUNTY, TEXAS — SHEET NUMBER 24

24

N

(Joins sheet 19)

(Joins sheet 23)

(Joins sheet 25)

(Joins sheet 30)

1 090 000 FEET

1 065 000 FEET

2 Miles

10000 Feet

5000

Scale 1:24000

0

1000

2000

3000

4000

5000 FEET

Creek

Sweetwater

ATCHISON, TOPEKA AND SANTA FE

NOLAN COUNTY, TEXAS — SHEET NUMBER 25

25

N

(Joins sheet 20)

(Joins sheet 24)

(Joins sheet 26)

(Joins sheet 31)

1,295,200 FEET

1,290,000 FEET

THE DIVIDE

Spring Creek

Cottonwood Creek

Oak Creek

Bear Creek

Barrell Spring

608

70

81

2 Miles

10000 Feet

Scale 1:24000

(Joins sheet 21)

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 32)

1 125 000 FEET

26

N

2 Miles

10000 Feet

Scale 1:24000

1 5000

¾ 4000

½ 3000

¼ 2000

0 1000

0

230 000 FEET

Holder Creek

THE DIVIDE

Bitter Creek

Nolan Divide

Nolan

NOLAN COUNTY, TEXAS — SHEET NUMBER 27

27

N

(Joins sheet 22)

(Joins sheet 28)

(Joins sheet 33)

Dora Community

Nolan

COUNTY

TAYLOR

Scale 1:24000

2 Miles

10000 Feet

28

N

2 Miles

10,000 Feet

1

5000

Scale 1:24000

0 0

1000 2000 3000 4000 5000

(Joins inset, sheet 17)

1,035,000 FEET

1245000 FEET

COUNTY

MITCHELL

Big Silver Creek

Cottonwood Creek

Banlett Creek

(Joins shimt 23)

(Joins upper right)

(Joins lower left)

Cottonwood Creek

Silver Creek

COUNTY

MITCHELL

Cottonwood Creek

(Joins sheet 29)

(Joins inset, sheet 39)

1,035,000 FEET

(Joins sheet 23)

(Joins sheet 28)

(Joins sheet 30)

(Joins sheet 34)

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

Plum Creek

Big Creek

Deer Drop Creek

Eagle Point Creek

Deadman Spring

Deer Drop Creek

Silver Creek

Cottonwood Creek

NOLAN COUNTY, TEXAS — SHEET NUMBER 30

30

N

(Joins sheet 24)

(Joins sheet 29)

(Joins sheet 31)

(Joins sheet 35)

1 090 000 FEET

1 065 000 FEET

2 Miles

10 000 Feet

Scale 1:24 000

ATCHISON TOPEKA AND SANTA FE

TOPEKA

AND

SANTA FE

Maryneal

Wilson Creek

608

1120

2176

NOLAN COUNTY, TEXAS — SHEET NUMBER 31

31

N

1 095 000 FEET

(Joins sheet 25)

(Joins sheet 30)

(Joins sheet 32)

(Joins sheet 36)

Bear Creek

Cottonwood Creek

Barrell Spring

Oak Creek

Brushy Creek

Robertson Creek

Cox Creek

Russell Creek

Robertson Creek

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

1¼ 5000

NOLAN COUNTY, TEXAS — SHEET NUMBER 32

32

N

(Joins sheet 26)

(Joins sheet 31)

(Joins sheet 37)

(Joins sheet 33)

1 150 000 FEET

1 125 000 FEET

THE DIVIDE

Pecan Creek

Pecan Creek

Pecan Creek

2 Miles

10000 Feet

Scale 1:24000

NOLAN COUNTY, TEXAS — SHEET NUMBER 33

33

(Joins sheet 27)

(Joins sheet 32)

(Joins sheet 38)

1 155 000 FEET

1 180 000 FEET

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

5000

COUNTY

TAYLOR

North Fork Valley Creek

South Fork Valley Creek

Draw

Wolf

NOLAN COUNTY, TEXAS — SHEET NUMBER 34

(34)

N

(Joins sheet 29)

1 060 800 FEET

(Joins inset, sheet 39)

1 036 200 FEET

(Joins sheet 40)

205 000 FEET

(Joins sheet 35)

Cottonwood Creek

Buck Creek

Silver Creek

Big Silver Creek

SANTA FE

ATCHISON TOPEKA AND SANTA FE

Scale 1:24000

2 Miles 1 0

10 000 Feet 5 000 0

1 000 2 000 3 000 4 000 5 000 Feet

NOLAN COUNTY, TEXAS — SHEET NUMBER 35

35

N

1 065 000 FEET

(Joins sheet 30)

205 000 FEET

(Joins sheet 34)

(Joins sheet 36)

(Joins sheet 41)

1 090 000 FEET

ATCHISON TOPEKA AND SANTA FE

Wilson Creek

2 Miles

10000 Feet

1

5000

Scale 1:24000

NOLAN COUNTY, TEXAS — SHEET NUMBER 36

36

N

(Joins sheet 31)

1 120 000 FEET

(Joins sheet 35)

(Joins sheet 37)

(Joins sheet 42)

1 095 000 FEET

Robertson Creek

Creek

Creek

Robertson

ATCHISON TOPEKA AND SANTA FE

2 Miles 1

10000 Feet 5000 0

Scale 1:24000

1 5000 ¼ 4000 ½ 3000 ¾ 2000 1 1000 0

NOLAN COUNTY, TEXAS — SHEET NUMBER 37

37

N

1 125 000 FEET

1 250 000 FEET

(Joins sheet 32)

(Joins sheet 38)

(Joins sheet 36)

(Joins sheet 43)

1 250 000 FEET

Oak Creek

Pecan Creek

Cottonwood Creek

Fish Creek

Pecan Creek

Oak Creek

Cottonwood Creek

2 Miles

10000 Feet

5000

0

1000

2000

3000

4000

5000

Scale 1:24000

38

N

2 Miles

10000 Feet

5000

1

Scale 1:24000

(Joins sheet 33)

(Joins sheet 37)

(Joins sheet 44)

1 180 000 FEET

COUNTY

TAYLOR

water

South Fork Valley Creek

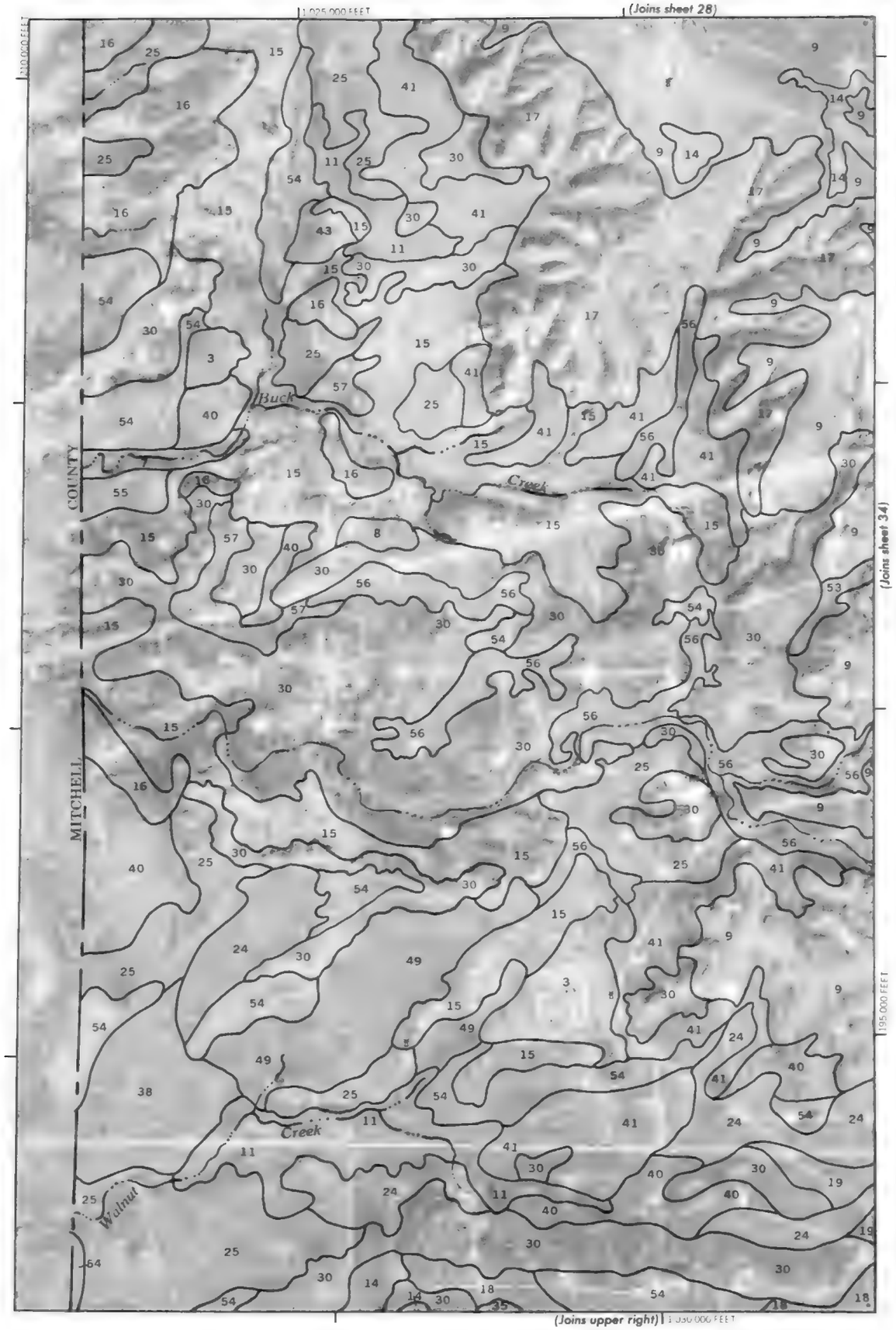
North Fork Valley Creek

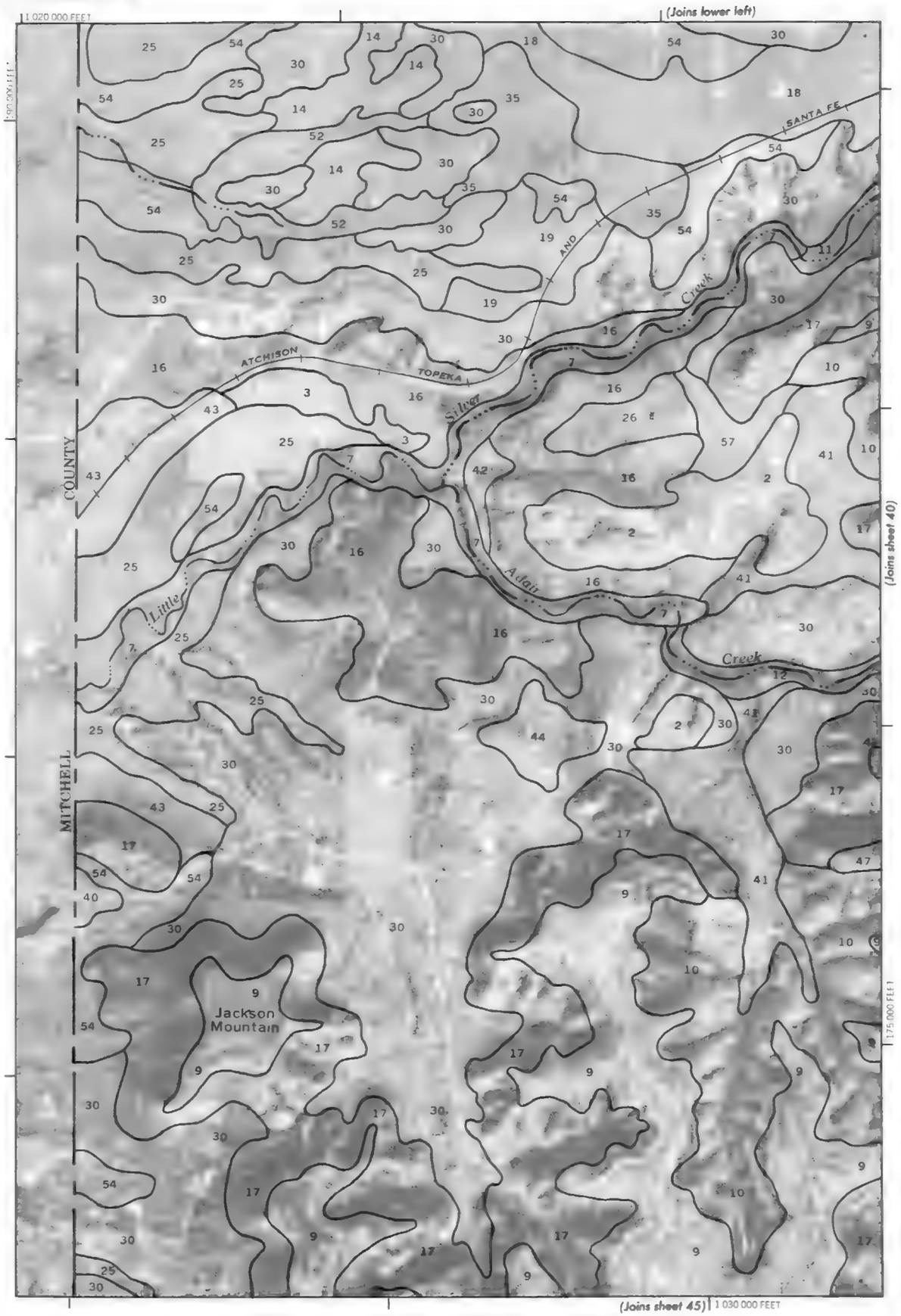
Valley Creek

Fish Creek

Magness Draw

53


1 025 000 FEET
(Joins sheet 28)
COUNTY
MITCHELL
Buck
Creek
Walnut
Creek
(Joins sheet 34)
1 950 000 FEET
(Joins upper right)
1 030 000 FEET


1 020 000 FEET
(Joins lower left)
COUNTY
MITCHELL
SANTA FE
AND
ATCHISON
TOPEKA
Silver
Creek
Little
Adair
Creek
Jackson
Mountain
(Joins sheet 40)
1 975 000 FEET
(Joins sheet 45)
1 030 000 FEET


N
2 Miles
10000 Feet
5000
Scale 1:24000
0
1000
2000
3000
4000
5000

NOLAN COUNTY, TEXAS — SHEET NUMBER 40

40

N

(Joins sheet 34)

ATCHISON TOPEKA AND SANTA FE

Little Creek

Silver Creek

Adair Creek

Yellow Hall Creek

(Joins sheet 39)

(Joins sheet 41)

1 035 000 FEET (Joins inset A, sheet 45)

Scale 1:24000

2 Miles 1 0 ½ ¼ ¾ 1

10000 Feet 5000 0 1000 2000 3000 4000 5000

NOLAN COUNTY, TEXAS — SHEET NUMBER 41

1 065 000 FEET

(Joins sheet 35)

Eagle Creek

Eagle Creek

Antelope Creek

(Joins sheet 40)

(Joins sheet 42)

(Joins inset B, sheet 45)

1 090 000 FEET

41

N

2 Miles

10000 Feet

Scale 1:24000

1 0 1 ½ 0 ½ 1

5000 4000 3000 2000 1000 0 5000

42

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

(Joins sheet 36)

1,120,000 FEET

185,000 FEET

(Joins sheet 41)

(Joins sheet 43)

(Joins inset A, sheet 46)

1,095,000 FEET

Eagle

Creek

Antelope

Creek

Creek

Creek

Creek

ATCHISON

TOPEKA

SANTA FE

1170

NOLAN COUNTY, TEXAS — SHEET NUMBER 43

1 125 000 FEET

(Joins sheet 37)

185 000 FEET

(Joins sheet 42)

(Joins sheet 44)

170 000 FEET

(Joins inset B, sheet 46)

1 150 000 FEET

43

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

Collonwood Creek

Oak Creek

Oak Creek

North Branch

Salt Creek

Salt Creek

Atlanta

44

N

(Joins sheet 38)

(Joins sheet 43)

(Joins sheet 46)

1 180 000 FEET

185 000 FEET

170 000 FEET

1 150 000 FEET

2 Miles

10000 Feet

5000

Scale 1:24000

5000 4000 3000 2000 1000 0 0 1000 2000 3000 4000 5000

Fish Creek

Hylton

Mountain

Cedar Mountain

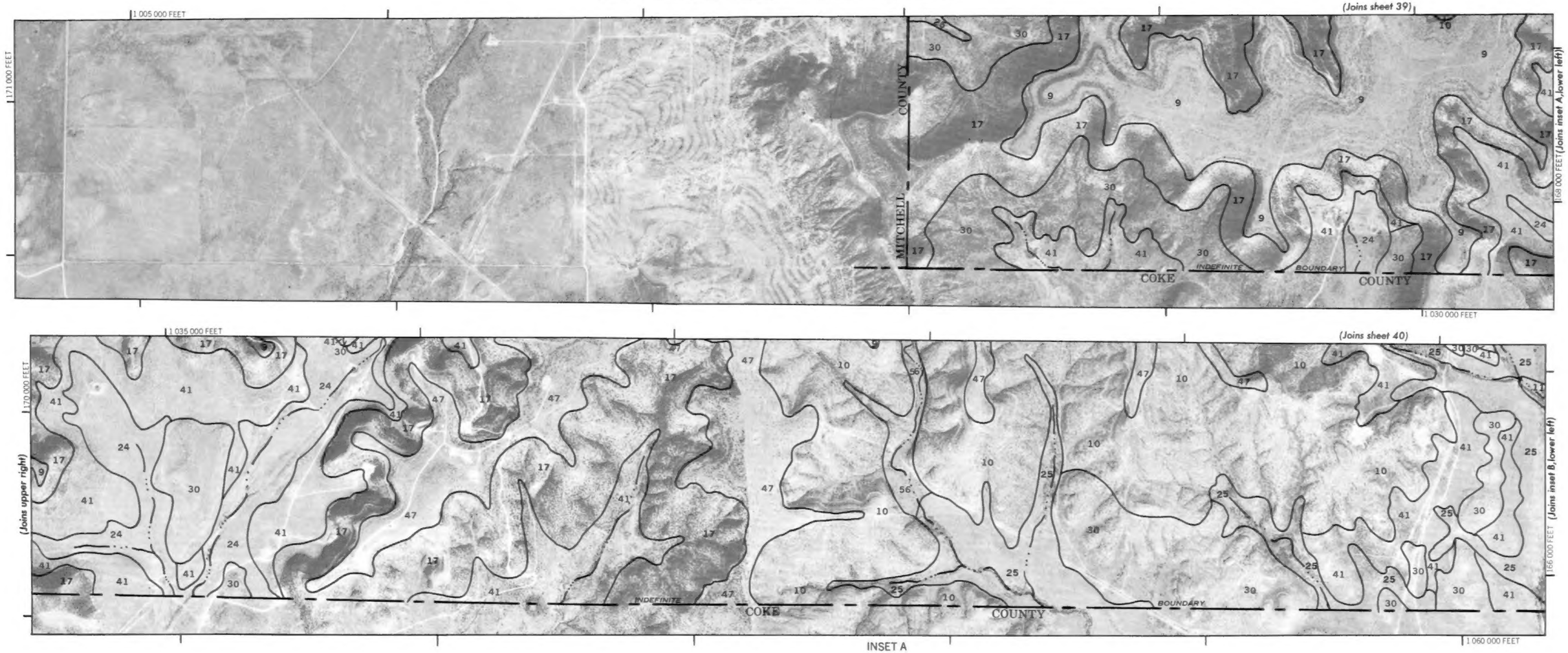
Cedar Gap

water

COUNTY

TAYLOR

NOLAN COUNTY, TEXAS — SHEET NUMBER 45



45

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 ¼ ½ ¾ 1 0 1000 2000 3000 4000 5000

46

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0

0

1000

2000

3000

4000

5000

(Joins sheet 44)

(Joins inset B, lower right)

1 180 000 FEET

165 000 FEET

Cedar Gap

Jackson Mountain

Mathis Mountain

Church Peak

Fish Creek

277

TAYLOR COUNTY

1 150 000 FEET

COKE COUNTY

RUNNELS COUNTY

INDEFINITE

BOUNDARY

(Joins sheet 43)

(Joins inset A, lower right)

(Joins inset B, upper left)

167 000 FEET

163 000 FEET

Oak Creek

North Branch

Salt Creek

Blackwell

ATCHISON, TOPEKA AND SANTA FE

1170

70

1 125 000 FEET

INSET B

(Joins sheet 42)

(Joins inset B, sheet 45)

1 120 000 FEET

168 000 FEET

164 000 FEET

Antelope Creek

1 095 000 FEET

INSET A